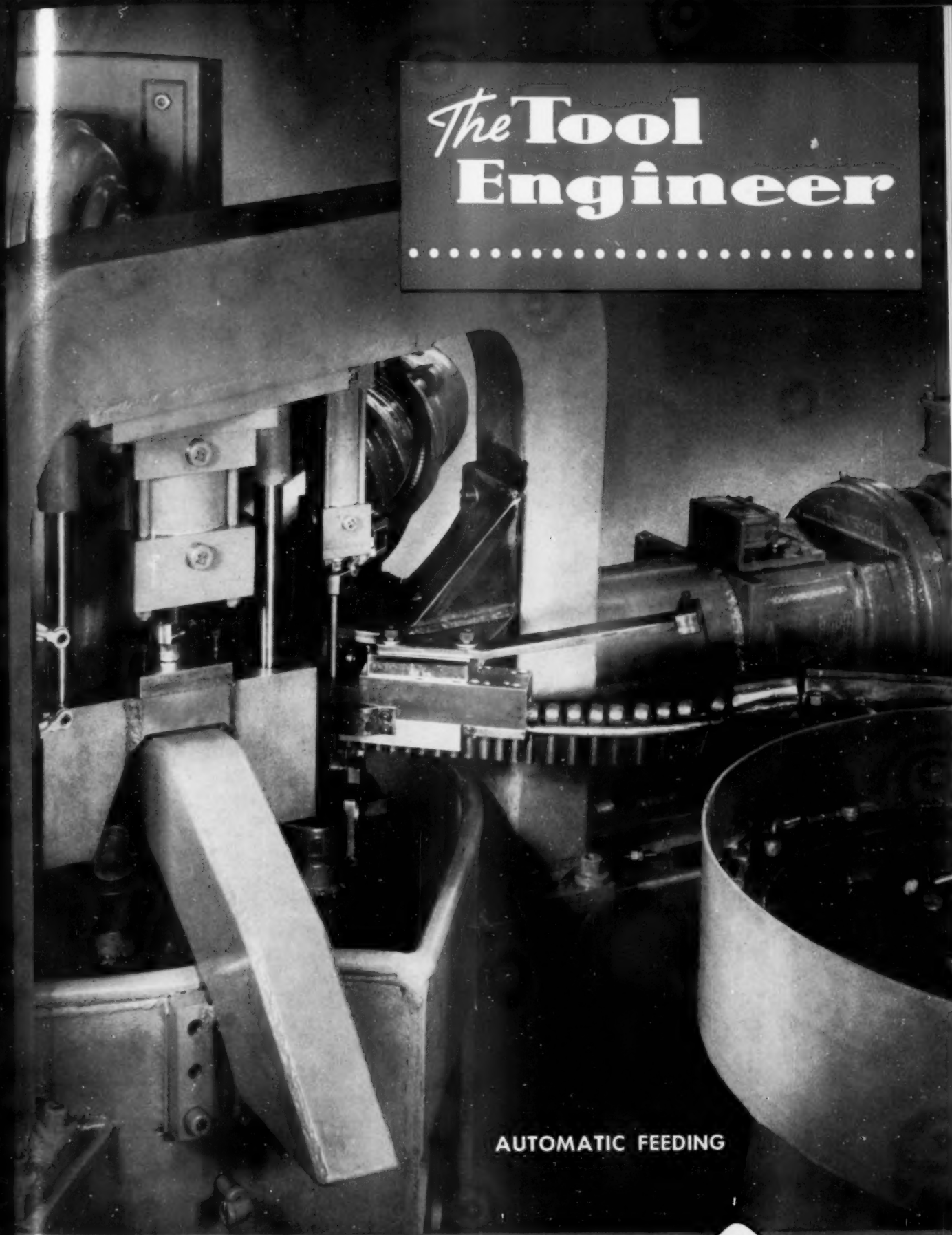


The Tool Engineer

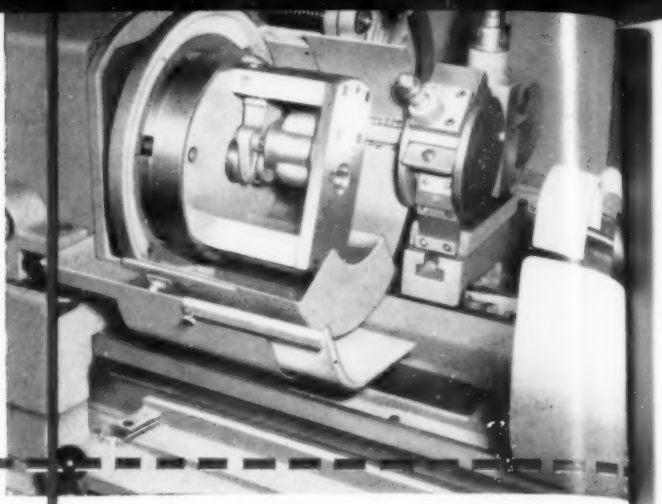
AUTOMATIC FEEDING

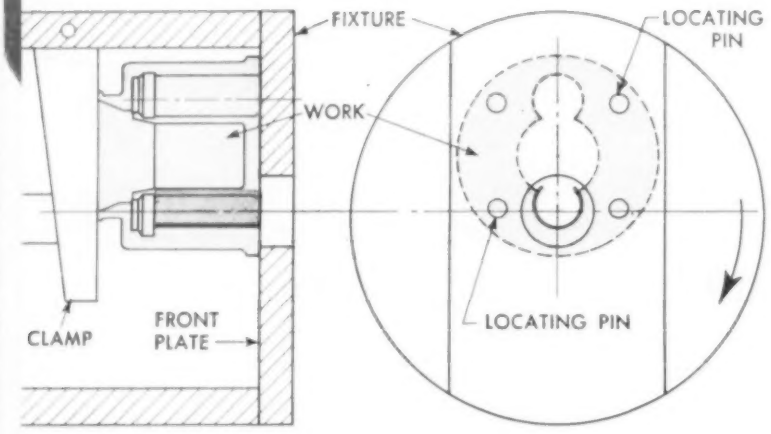
PUBLICATION OF THE AMERICAN SOCIETY OF TOOL ENGINEERS

APRIL, 1953

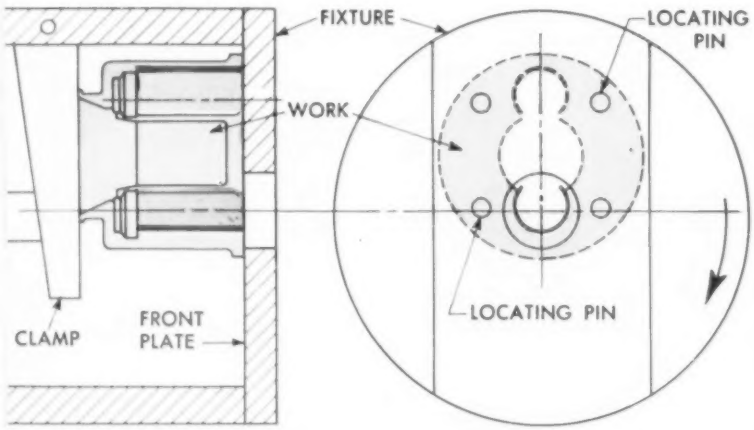
Heald Model 271 Size-Matic grinds

TWO OFF-CENTER BORES





Side and end view of clamping fixture with universal joint body in place. Color indicates surface ground in first operation.



Here part has been turned 180° in fixture and the second open-sided bore has been ground.

Universal joint body with double, open-sided bore, turned 180° in fixture for secondary grind

You can't grind two off-center holes in a rotating part at the same time. So you grind them in sequence. In such cases, it's important to have a work-holding fixture that permits fast, easy relocation of the part for the secondary grind. Here's a typical example.

The machine, a model 271 Size-Matic, is designed for precision internal grinding of double open-sided bores in universal joint bodies. The work is hydraulically clamped in a quick-change, balloon type fixture. After the first bore is ground, the part is simply unclamped, turned 180° in the fixture, reclamped and ground on the second bore. Note that the holes are open on one side, giving an interrupted surface for the grinding operation.

The part locates against the flange face and on pins through holes in the part.

Remember—when it comes to precision finishing, it pays to come to Heald.

HEALD

Case Study
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Cover: Vibrating hopper automatically feeds clevis pins into 8-station dial machine. Designed by Hautau Engineering Co., this machine loads, drills, checks, chamfers, reams and unloads at the rate of 600 an hour. Other types of hopper feeds are discussed in the article beginning on page 73.

The Tool Engineer

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THE TOOL ENGINEER is regularly indexed in *The Industrial Arts Index.*

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THE TOOL ENGINEER

Publication of The American Society of Tool Engineers

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The Tool Engineer

Controls for Automation

With automation becoming vitally important in many production lines, the tool engineer's responsibility for being familiar with latest developments and practices is evident. No longer are these advances restricted to mass production techniques. Many of them are proving economical and advantageous in medium-production plants and some in relatively small operations.

Controls are basic in all forms of automation because they integrate the various elements in the system. Whether automation involves synchronization of related machines, transfer machines, or complicated mechanisms, its successful operation depends upon adequacy of its controls. Adjustable-speed drives with speed regulation within definite limits sometimes prove to be a governing factor. Often, proper sequencing of related machine elements requires positive operation from an initial signal which in itself is too weak to provide the impulse needed for the following operation.

For these conditions power amplifiers of one type or another are generally employed. When, however, it becomes necessary not only to initiate an operation but also to measure it and compare it with the initial signal, servo systems become important.

Fundamental characteristics and features of such systems are clearly discussed in the article by J. Y. Kaplan beginning on page 53 of this issue. He reviews the basic elements of a classical open-loop circuit and then illustrates how, by incorporating additional control elements, the open-loop becomes a closed-loop circuit or a servo system. Response requirements with respect to precision controls are evaluated. In his succeeding article to be published in the following issue, the author shows how these controls are effectively applied to production machines.

With information such as this at his finger tips and control elements with standardized characteristics available to him, the tool engineer is able to use the most economical control with the characteristics required for his application.

John W Greve

EDITOR

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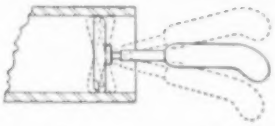

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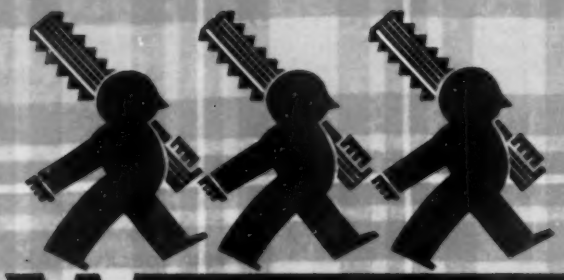

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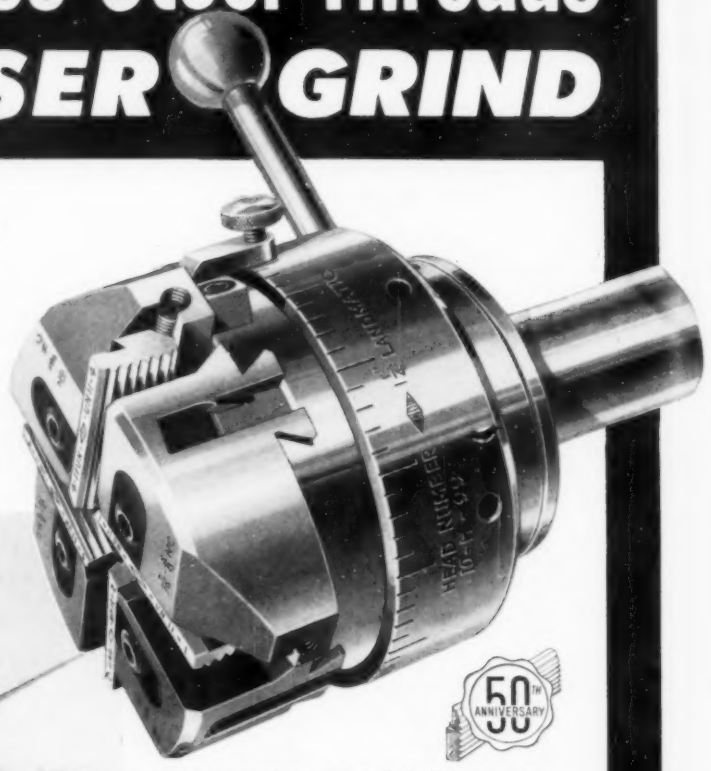
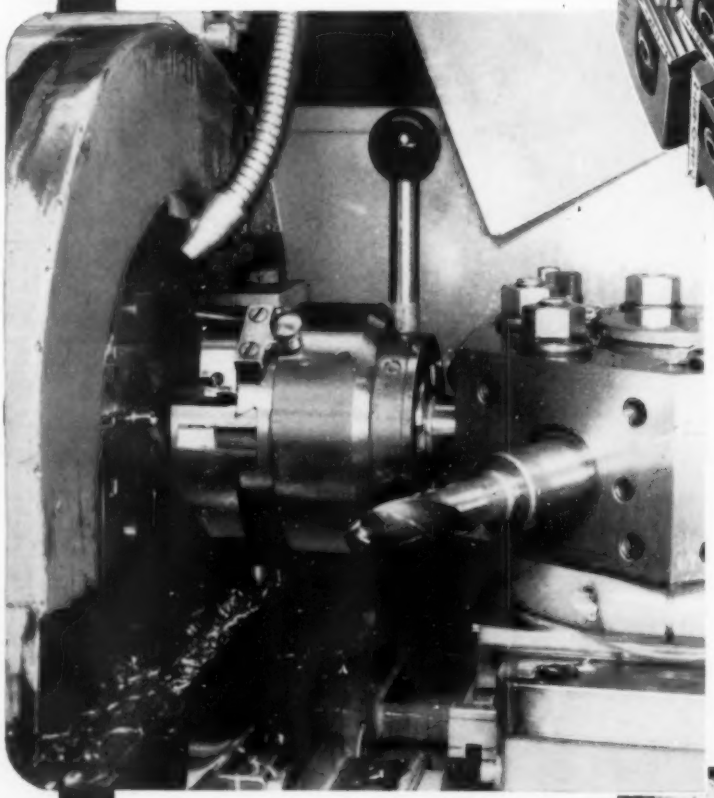
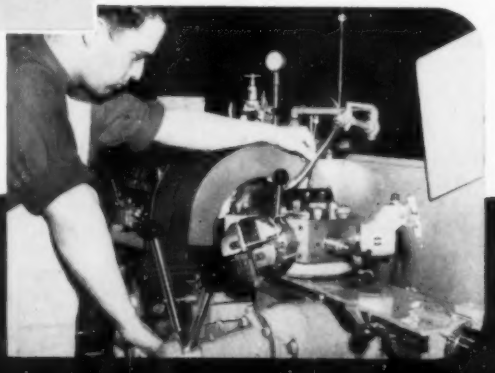




LANDMATIC Hardened and Ground Heads, such as used by Crawford, are designed to produce threads to Class 3 or 4 fit in all types of tough materials. Unusually heavy construction and sound fundamental die head design assure the rigidity necessary for accurate threads. The inherent features of the design of the Landis Tangential Chasers and their proper manufacture and hardening, developed during 50 years of threading experience, ensure long chaser life and low threading cost.

If you require threads on stainless steel or other tough material, LANDMATIC Hardened and Ground Heads offer you these same cost-saving features. Please send specifications and write for Bulletin F-80 for additional information.



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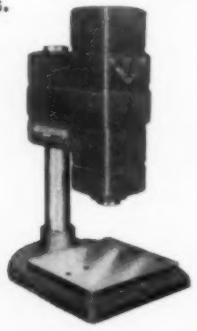

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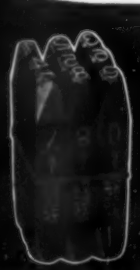

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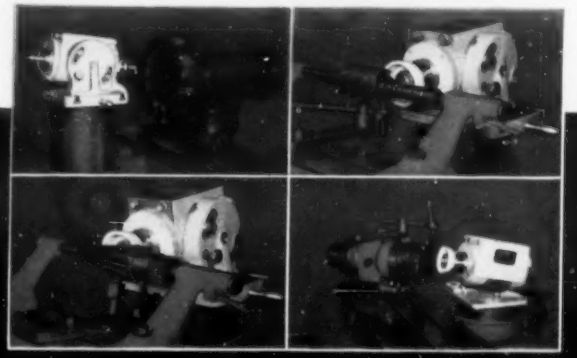

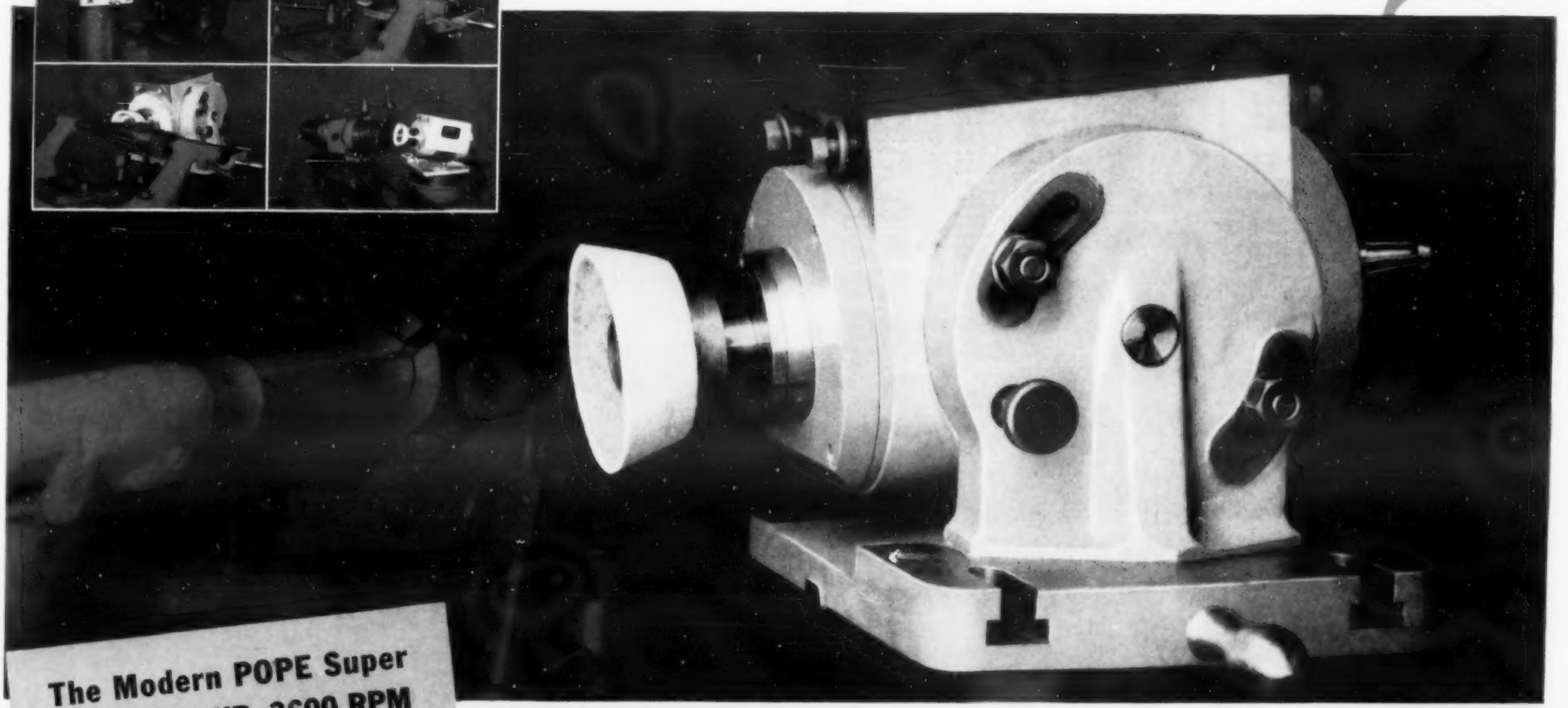

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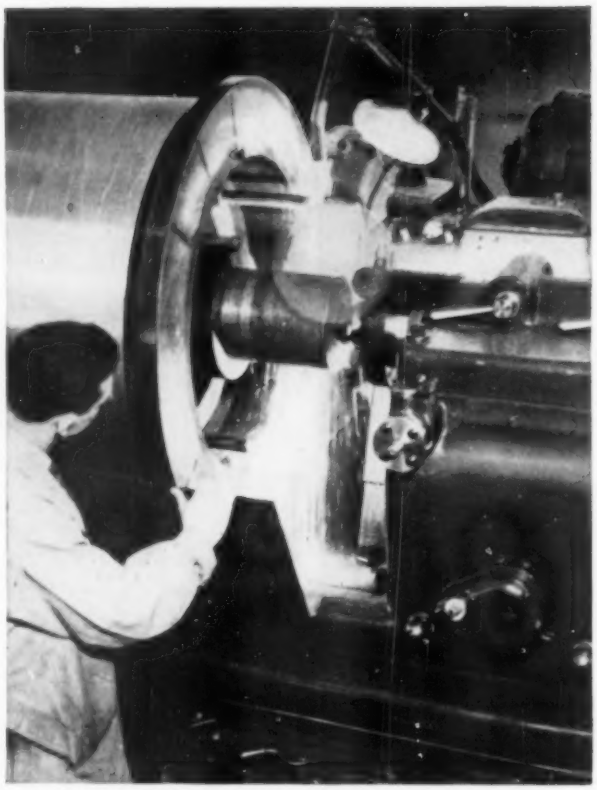

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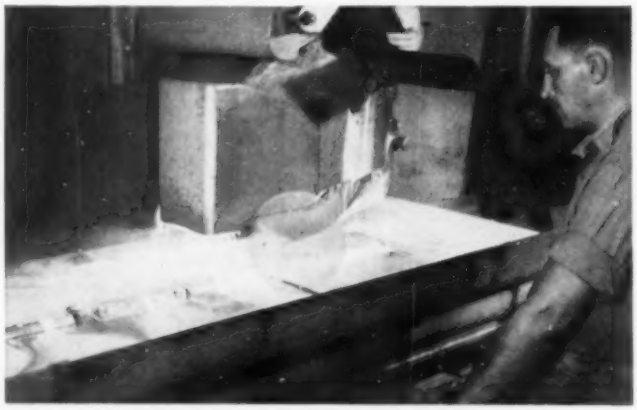

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- Dress easier — more pieces per dressing
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- Hold corners better
- Ideal for crush dressing

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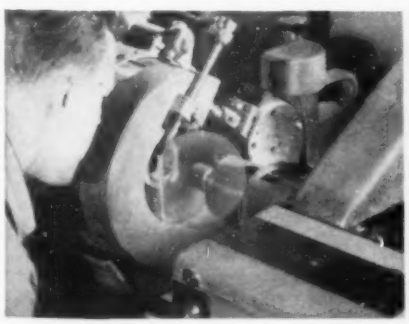

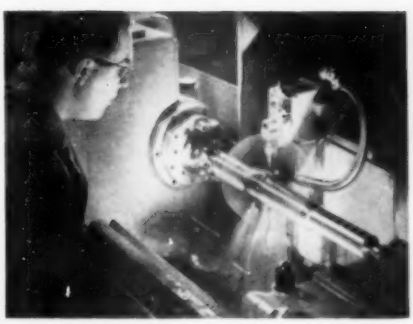

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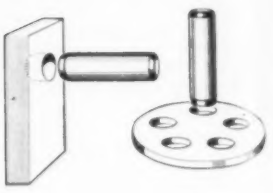

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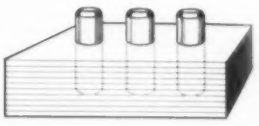
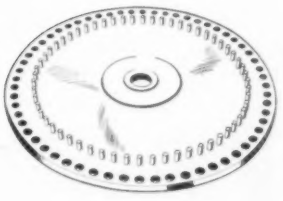


As fasteners for laminated sections, machine parts. As roller bearings in casters, truck wheels, etc.



As position locators on indexing machines, for aligning parts, as feeler gages in assembly work, as valves and valve plungers on hydraulic equipment.

UNBRAKO PRECISION-GROUND ALLOY STEEL DOWEL PINS feature the following: formed ends which won't chip; 60-62 Rockwell "C" Scale surface hardness; 6 micro-inch maximum surface finish; 50-54 Rockwell "C" Scale core hardness; 150,000 psi average single shear strength; ±0.0001" diameter tolerance; 2 standards—blue label pins, .0002" oversize for nominal press fit requirements and red label pins, .001" oversize for use as repair pins.

See your distributor for UNBRAKO standards

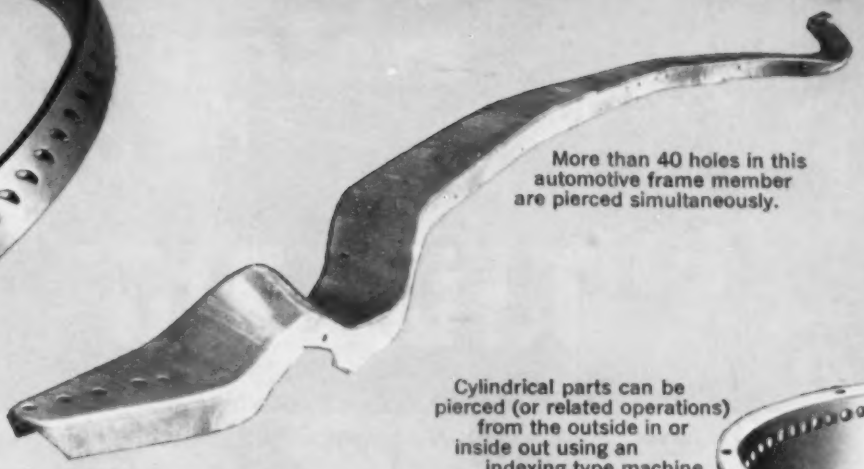
You save time and money ordering UNBRAKO socket screw products from your UNBRAKO industrial distributor. He has a complete stock, offers excellent service and prompt deliveries. Write for UNBRAKO Standards. SPS, Jenkintown 37, Pa.

Write for UNBRAKO Standards

UNBRAKO® SOCKET SCREW DIVISION

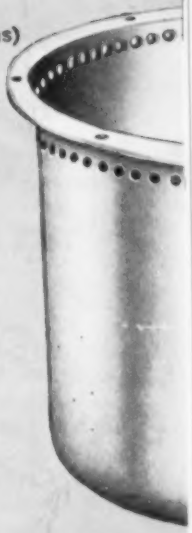
SPS
JENKINTOWN PENNSYLVANIA

Irregularly shaped holes are pierced in this stainless steel jet engine part to very close tolerances—automatically.



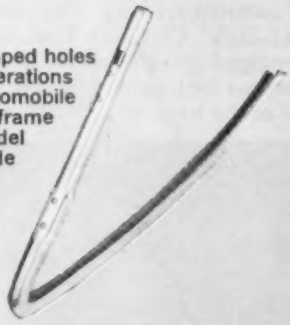
More than 40 holes in this automotive frame member are pierced simultaneously.

Cylindrical parts can be pierced (or related operations) from the outside in or inside out using an indexing type machine.



High Production Piercing...

IN A SINGLE SET-UP



Seven irregular shaped holes and two trimming operations complete this automobile door inner window frame in one setup. Model changes can be made at little expense.

Based on a recent development in piercing technique, you can pierce more holes simultaneously—faster and with greater accuracy—on Danly Metalworking Equipment. Eliminate awkward multiple handling . . . pierce all holes faster in a simple, single set-up.

Built specifically for your piece part, these are only a few of the advantages of Danly Hydraulic Metalworking Equipment:

FREE

Write for this Bulletin today!

Consider these important features!

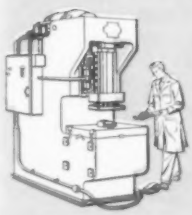
- *HIGH CAPACITY*—Up to 225 tons available per cylinder.
- *BREAKTHROUGH SHOCK PRACTICALLY ELIMINATED*—Permits greater capacity without hydraulic circuit or tool trouble . . . smoother, faster.
- *AUTOMATIC STRIPPING*—An integral feature of every cylinder . . . each station hydraulically strips its punch. This unique action simplifies fixturing, is practically foolproof.
- *ACCURACY, FLEXIBILITY*—Pierces practically any type of hole . . . round, oblong or irregular to very close tolerances.

DANLY®

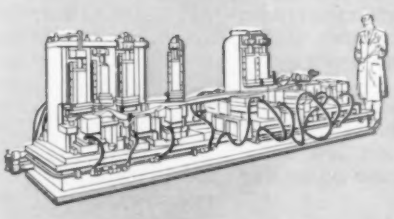
DANLY MACHINE SPECIALTIES, INC.
2100 South Laramie Avenue • Chicago 50, Illinois

HYDRAULIC METALWORKING EQUIPMENT
MECHANICAL PRESSES . . . 50 TO 3000 TONS

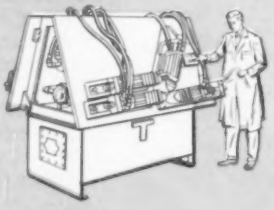
DANLY HYDRAULIC METALWORKING EQUIPMENT



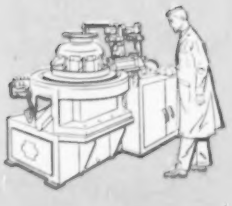
General Purpose Gap Frame Piercing Press



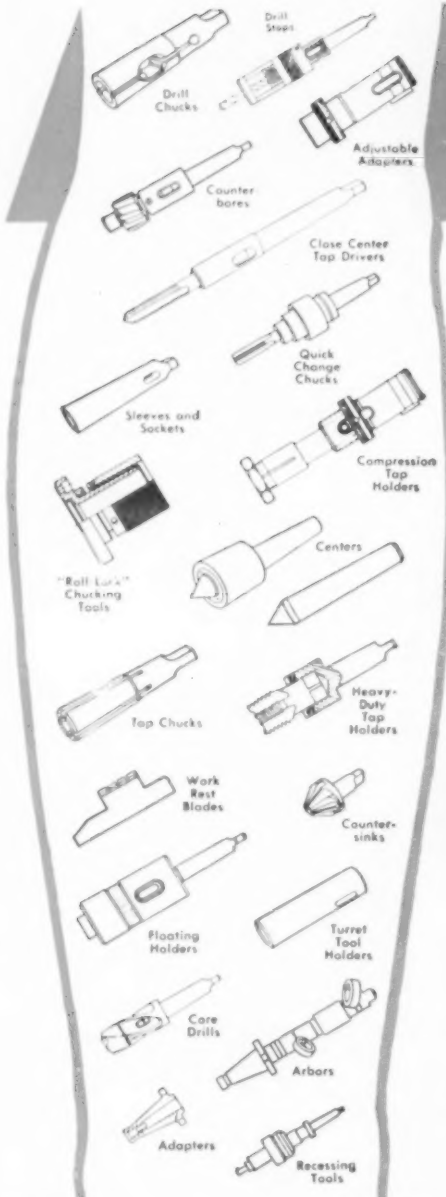
Automotive Frame Piercing Machine



Automotive Inner Window Frame Piercing Machine



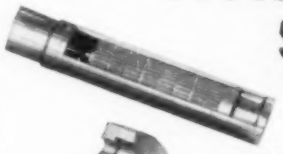
Jet Engine Shroud Ring Piercing Machine



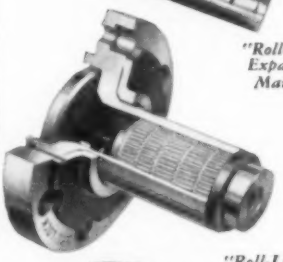
THE NEW CHUCKING TOOLS

POWERFUL AND ACCURATE

. . . for precision work



"Roll-Lock" Expanding Mandrel



"Roll-Lock" Flange Type Expanding Arbor

"Roll-Lock" Flange Type Chuck

Shown to the right are two of the many applications in turning, grinding or inspection operations. "Roll-Lock" Flange Type Expanding Arbor and Tool Chuck being used in a finish grinding machine for holding the work and grinding tool.

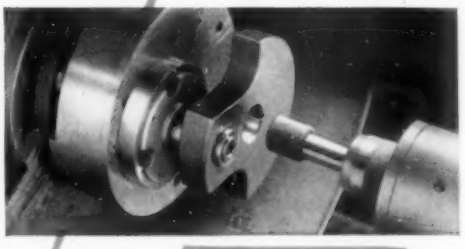
•"Roll-Lock" is a trade mark of Scully-Jones and Company.

S-J SCULLY-JONES

"ROLL-LOCK"* CHUCKING TOOLS

"Roll-Lock" Mandrels, Arbors and Chucks use a new chucking method for holding work or tools. This method takes advantage of the elastic properties of metal.

When a very little turning force is applied to actuating ring or cone, the powerful wedging action of rollers expands or compresses the chucking surface to a shrink fit. This permits maximum torque and thrust to be transmitted, assuring accuracy often less than .0001". "Roll-Lock" Chucking Tools are engaged or disengaged quickly and easily. Yet the shrink fit cannot be loosened by reversing the rotation of the tools or by shock and vibration.



WRITE FOR BULLETIN No. 17-50

giving detailed description and technical data on these and other "Roll-Lock" Chucking Tools.

Scully-Jones AND COMPANY

1915 S. Rockwell St., Chicago 8, Ill.

R58 28

YOU GET LOW COST FAST ACCURATE PRODUCTION WITH OUR STANDARD AND SPECIAL TOOLS

the "ARMS and HANDS" for your MACHINE TOOLS

If you think of a Lathe, Mill, Multi-Spindle Machine, or other Machine Tools as being a human body, supplying power to the parts of the body doing the actual work, then Scully-Jones tools represent the "Arms and Hands"

YOUR PROBLEMS ARE OUR PROBLEMS

Helping you solve your tooling and production problems is Scully-Jones first objective. Ever since 1912 we have designed, developed and manufactured tools to the highest standards to help you get fast, accurate production at low cost.

That is why you can purchase S-J Tools and get the best that engineering research, modern equipment, correct materials and expert workmanship can produce.

Use these S-J "Arms and Hands" to equip your machine tools. They will help you get low cost, fast, accurate production on such operations as drilling, reaming, tapping, milling, counterboring, countersinking, core drilling, recessing or undercutting, boring and grinding.

For current information on S-J Tools, refer to Catalog 600. Write on your company letterhead for your copy.

Let us help you solve your tooling and production problems. Because our manufacturing facilities have been expanded, we're in a position to give you reasonable deliveries. For quick service see our nearest representative or contact Scully-Jones direct.

Production Pointers from GISHOLT

TIME-SAVING IDEAS

Presented as a service to machine shops, we hope some of these interesting ideas, culled from thousands of jobs, will suggest ways to help you cut time and costs in your own metal work.

AN EXCELLENT WAY TO MACHINE GATE VALVE PARTS

No. 12 Hydraulic Lathe Performs 5 Operations with One Set of Tools

Valve seat rings and gate wedges.

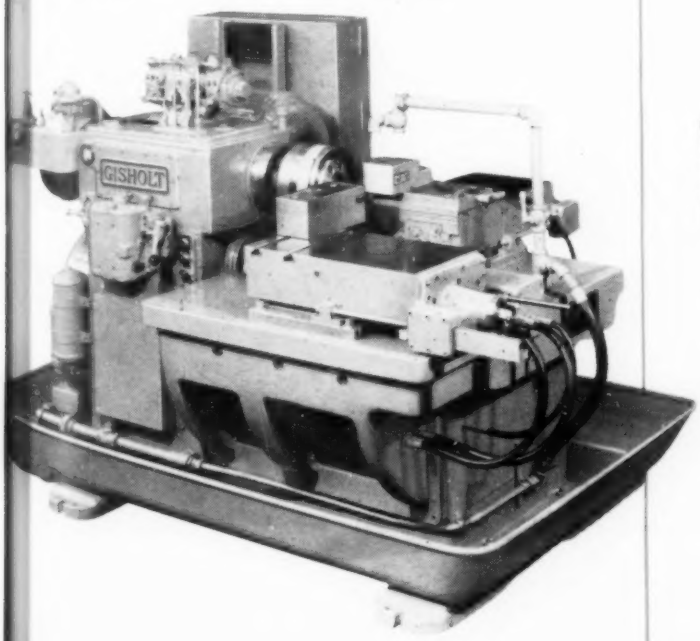
Here is an efficient setup for producing seat rings and slotted wedges for gate valves. A Gisholt No. 12 Hydraulic Automatic Lathe is doing the work on the stainless steel parts requiring close tolerances.

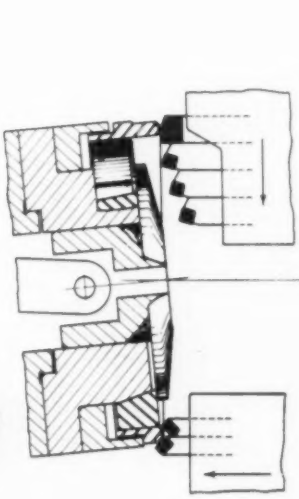
A total of six tools is used to machine the 8" five-degree valve seat rings which are held in a special fixture. Tools on the rear slide rough and finish face while tools on the front slide chamfer inside and outside the seat diameters. The workpiece is held on an air-operated expanding mandrel set at five degrees from the spindle axis. Time is only 3 minutes floor-to-floor.

Changeover for machining the wedges is fast and easy. The same tooling is used and a 2-jaw chuck replaces the fixture. The gates are then machined on one side. To do the next side, the workpiece is reversed. After this operation the part is heat-treated. It is then returned to the No. 12 and light finishing cuts are taken on both sides, leaving a 30 to 40 micro inch RMS finish. Time for each side is 2 minutes. Locating blocks are adjustable and different sizes can be handled with this setup.

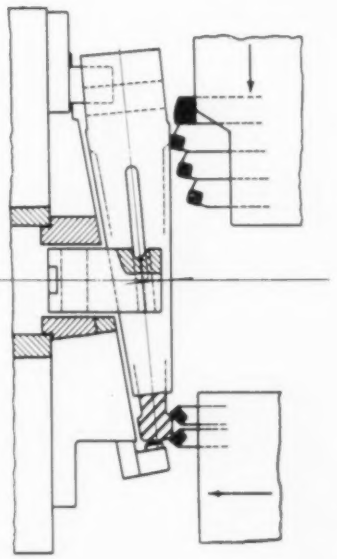
This No. 12 Hydraulic Lathe with its completely automatic cycle, and well planned tooling handles various sizes of two different parts.

The No. 12 Hydraulic Automatic Lathe.





Tooling and fixture for machining seat rings.



Same tooling with 2-jaw chuck for wedges.

GISHOLT

TIME-SAVING IDEAS

TRY THIS TIME-SAVER ON MULTIPLE FACE PARTS

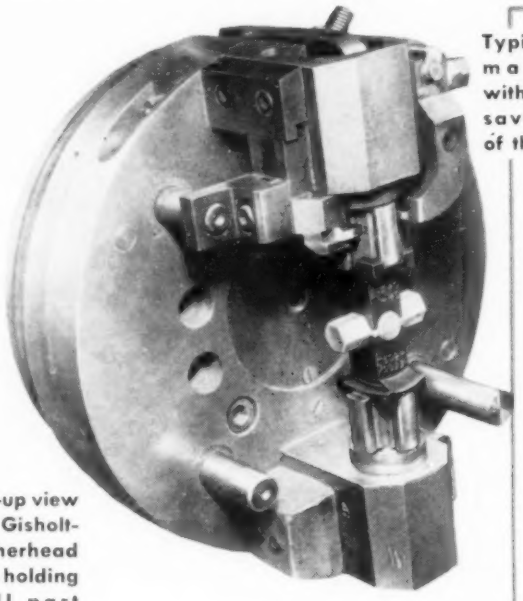
Work is Indexed Without Stopping Spindle

Do you have the problem of machining two or more sides or ends of small parts? The Gisholt-Weatherhead chuck, mounted on a No. 5 Ram Type Turret Lathe, can be your time-saving solution.

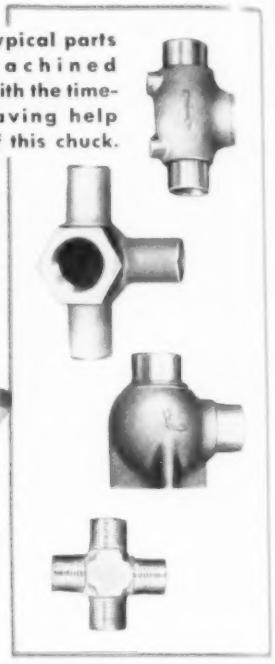
This quick-indexing, two-jaw chuck is air-operated. It permits you to index the workpiece *without* stopping the spindle. It's an important time-saving feature that means more production per hour; easier work for the operator.

If you machine small to medium size valves, cocks, tees, ells, crosses and similar multiple station parts, you should have full information on the Gisholt-Weatherhead chuck. Ask for the Gisholt Chuck catalog.

Here's a Production Pointer that tells how to machine similar faces of parts without unchucking the part . . . or even stopping the spindle.



Close-up view of the Gisholt-Weatherhead chuck holding small part machined on all four sides.



Typical parts machined with the time-saving help of this chuck.

ON JOBS LIKE THIS POWER AND RUGGEDNESS PAY OFF

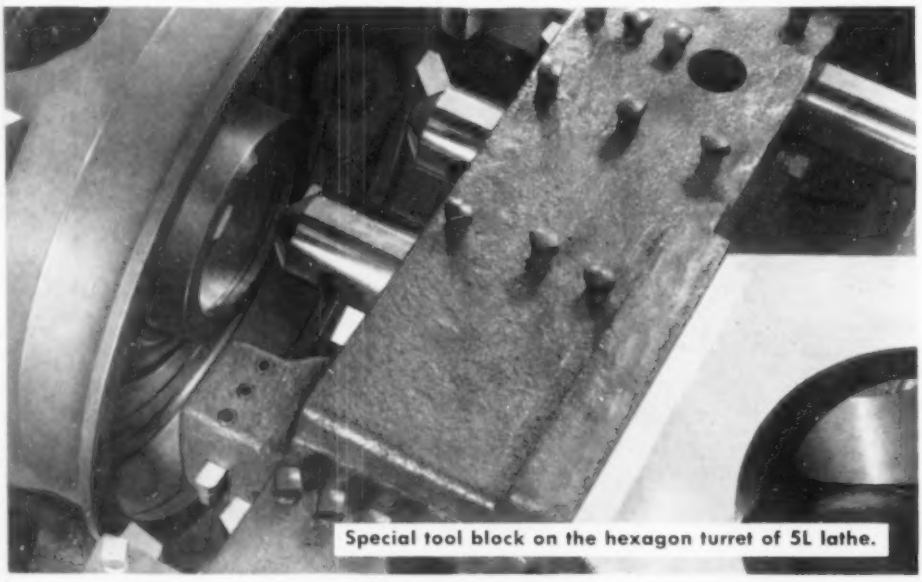
Big Saddle Type Lathe Has Cross Feeding Turret

For hogging off metal on hefty parts, like this heavy steel aircraft engine crankcase section, it takes a machine with plenty of power and rigidity.

This big 5L Saddle Type Lathe with its 36½" swing over the bedways is up to the job on both counts. It's equipped with a 50 H.P. driving motor and has a cross-feeding turret. There's a special tool block mounted on one face of the hexagon turret which feeds into the work and then laterally so that the seven separate tools handle all operations. The rim is turned and faced, two diameters are bored and both OD and ID are rough formed—all in this one movement. Then the tools on the square turret finish form the OD and ID.

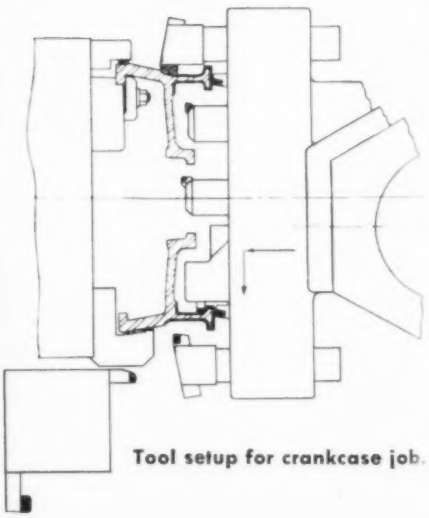
It's another case where the sheer power and ruggedness . . . plus combination tooling of a standard Gisholt Saddle Type Lathe . . . pay off on a special job. Once the job is completed, the machine can be quickly tooled for standard turret lathe work.

You should have the Bulletin on the 5L Saddle Type Lathe if your work is of this size. Write; we will also include information on standard tools.



Special tool block on the hexagon turret of 5L lathe.

Seven tools combined on one head plus a sturdy turret lathe give fast production on unusual job.



Tool setup for crankcase job.

GISHOLT

TIME-SAVING IDEAS

2 JOBS—1 MACHINE—1 TOOL SETUP

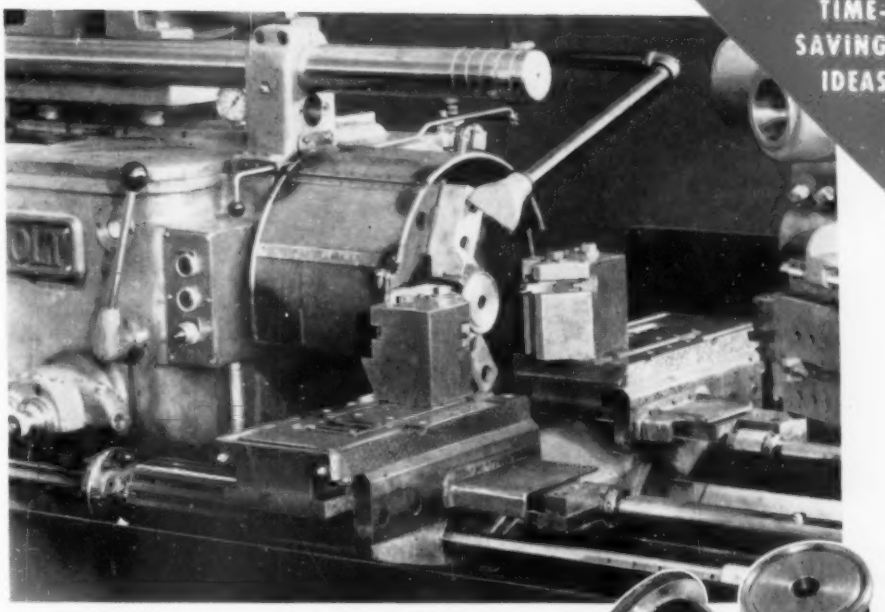
Valve Guide Machining Shows How It's Done

The two operations required to machine these valve guide parts are handled as separate jobs on this Fastermatic Automatic Turret Lathe. Yet, both jobs are done with just *one* set of tools on the hexagon turret.

For the first operation, tools are used in stations 1 and 2 of the hexagon turret. These do rough and finish turning while tools on the cross slides face, form and chamfer. Meanwhile, through the use of the reduced travel feature of the Fastermatic, the rest of the turret stations are by-passed.

For the second operation, the tools which were already set up and inactive in the first operation are now utilized. By merely changing the tools on the front and rear cross slides, the second operation is completely set up. This time tools on the hexagon turret do turning, boring and grooving, while tools on the cross slides face, form and chamfer.

This Fastermatic feature saves setup time and makes changeover fast and simple.



Close-up showing tooling on front and rear cross slides.

There's no re-tooling of the hexagon turret between operations on this job because all tools for both operations are there from the start.

Valve guide before and after machining.

HOW ALL ANGLES ARE COVERED ON THIS FAST SIMPLIMATIC JOB

Adjustable Tool Slides Cope with Different Cone Angles

Rotary rock bits for oil well drilling are big business. Here, production is getting a big boost by an excellent setup on a Gisholt Simplimatic Automatic Lathe.

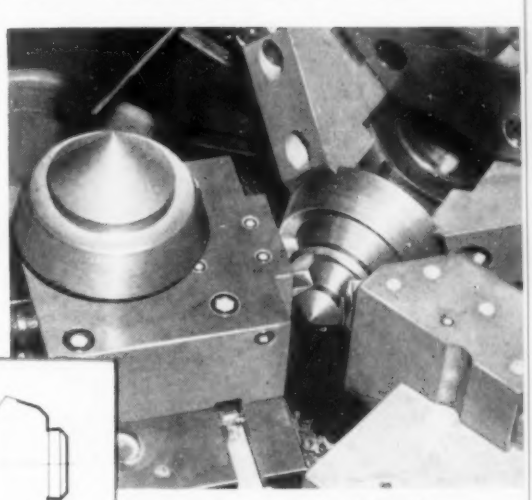
It's handling first and second operations on the three types of bits shown in the drawing. In the first operation, front-slide turning tools turn the various angular outside surfaces. Time: 1.5 Min. f.t.f.

In the second operation, tools on the front and rear slides groove the cutter bits in only .8 minute.

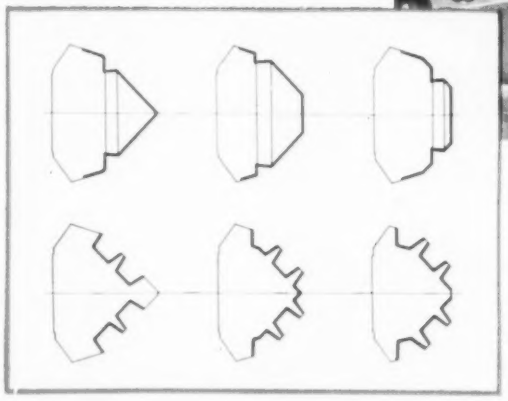
A time-saving feature of the tool slides are their swivel bases which make them adjustable for machining the different cone angles required by the three types of bits.

With one set of tools, this Simplimatic handles two operations on three types of rock bits—all having different angles.

Workpiece after first and second operations.



Second operation in machining rock bits.



The 3 types of rock bits.

GISHOLT

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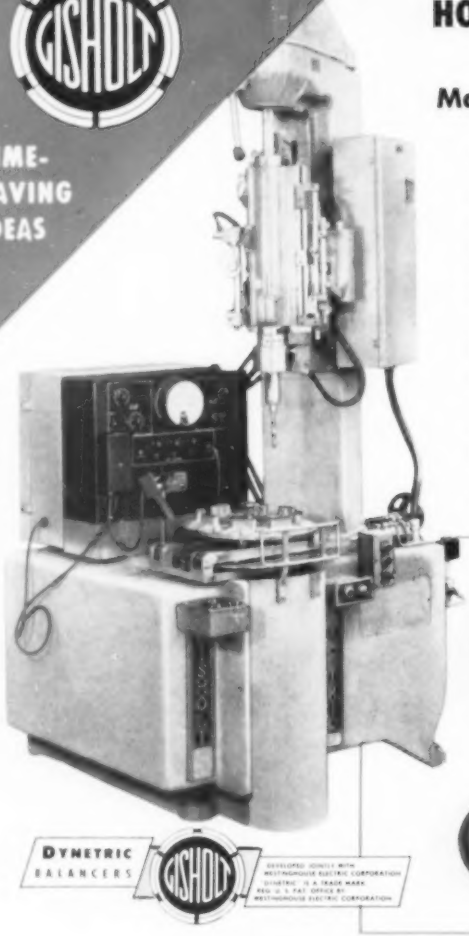
TIME-SAVING IDEAS

HOW BALANCING HELPS TAKE THE SHAKES OUT OF TRACTORS

Machine Measures and Corrects Unbalance in Variety of Parts



Balancing does wonders, as this tractor manufacturer has learned. Operation is smoother and vital parts last longer because flywheels and clutch components are precision balanced on a Gisholt 1SV1 DYNETRIC Balancer.

Static unbalance is measured, located and corrected on the one machine. The operator reads the amount of unbalance from the large meter. Correction is then made by the integral-mounted drill which removes the exact amount of metal to bring the part into balance.

This Balancer handles a wide assortment of parts, ranging from 10 to 65 lbs. and up to 21 inches in diameter. Special adapters are used to locate, support and hold each type of workpiece.

For full information on balancing, write for the booklet, "Static and Dynamic Balancing." Also ask for details on Gisholt Balancing School.

Static balancing is a quick, inexpensive operation that gives these tractor parts longer life with less vibration.

A few of the many tractor parts balanced on this machine.

50-SECOND SUPERFINISHING OPERATION—YEARS LONGER BEARING LIFE

Gisholt Model 51-A Cylindrical Superfinisher with workpiece in place.

Job Done Automatically

The part you see loaded in this Gisholt Model 51-A Superfinisher is a planetary gear housing. Two bearing diameters, one measuring 3⅛" and the other 1½", are being Superfinished.

The two-speed rough-and-finish machine cycle is predetermined, adjustable and fully automatic, except for loading. With the part held by an air-operated draw-back fixture, both bearing diameters are simultaneously Superfinished from approximately 20 micro inches RMS down to 6-8. A special upper oscillating head with two quill units, one standard and the other with 4" vertical travel, clears the workpiece for loading and unloading. Floor-to-floor time is only 50 seconds and production is 57-60 parts per hour at 80% efficiency.

Superfinishing, by ridding the bearing surfaces of smear metal, chatter marks and other irregularities, greatly increases the service life of the parts.

In one fast automatic operation, Superfinishing gives these two bearing surfaces a smoothness that assures much longer life.

The textbook, "Wear and Surface Finish" covers all phases of Superfinish. Your copy is free for the asking.

No. 3-453

607

GISHOLT

THE GISHOLT ROUND TABLE represents the collective experience of specialists in the machining, surface-finishing and balancing of round and partly round parts. Your problems are welcomed here.

GISHOLT MACHINE COMPANY Madison 10, Wisconsin

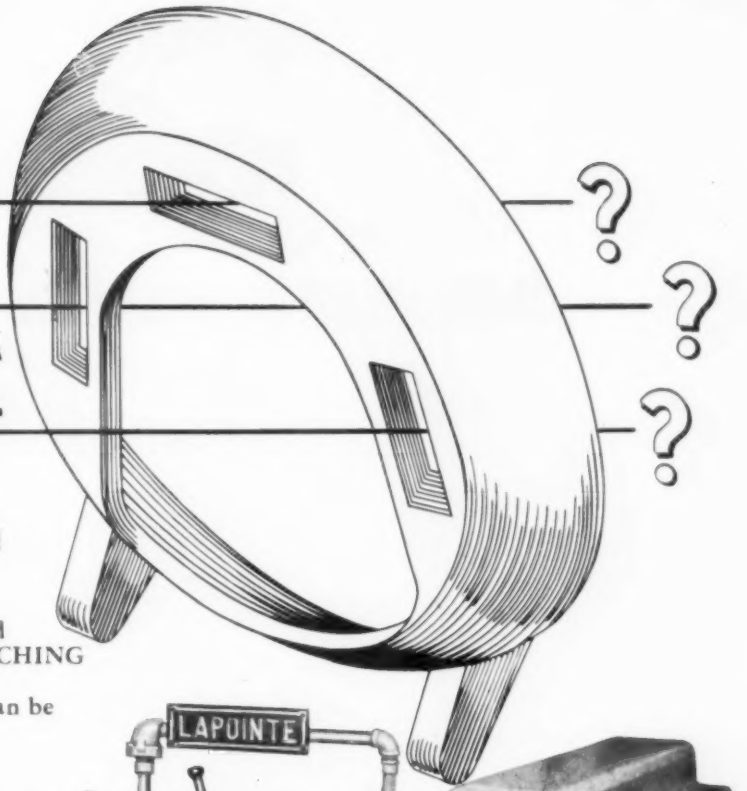
TURRET LATHES • AUTOMATIC LATHES • SUPERFINISHERS • BALANCERS • SPECIAL MACHINES

HOW WOULD YOU

MACHINE THE ENDS OF THESE
3 RECTANGULAR HOLES, AT AN ANGLE,
IN THIS

COMMANDER'S CUPOLA
forged of ARMOR STEEL

it's easy and accurate
with **LAPOINTE BROACHING!**



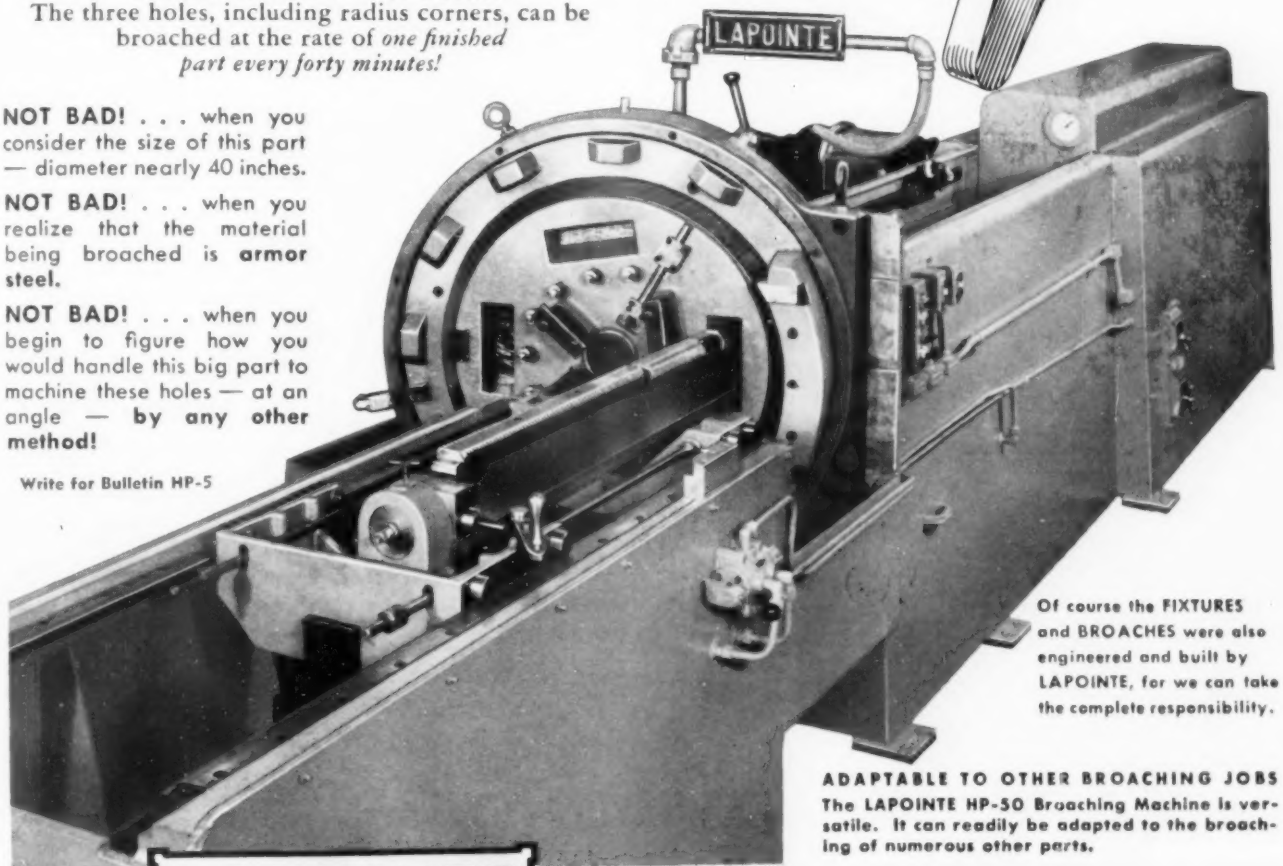
The best way to do it is to use this rigid 25-ton LAPOINTE HP-50 Horizontal BROACHING MACHINE with 72-inch stroke. The three holes, including radius corners, can be broached at the rate of *one finished part every forty minutes!*

NOT BAD! . . . when you consider the size of this part — diameter nearly 40 inches.

NOT BAD! . . . when you realize that the material being broached is **armor steel.**

NOT BAD! . . . when you begin to figure how you would handle this big part to machine these holes — at an angle — **by any other method!**

Write for Bulletin HP-5



Of course the FIXTURES and BROACHES were also engineered and built by LAPOINTE, for we can take the complete responsibility.

ADAPTABLE TO OTHER BROACHING JOBS
The LAPOINTE HP-50 Broaching Machine is versatile. It can readily be adapted to the broaching of numerous other parts.

THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U. S. A.
Branch Factory: Watford, Herts., England

HUDSON LAPOINTE MASS

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES

FOR FURTHER INFORMATION, USE READER SERVICE CARD: INDICATE A-4-21

When you want on any cutting-tool

here are 5 reasons to call your MORSE-Franchised DISTRIBUTOR

1 COMPLETE LINE: Drills, Taps (including a new line of Special-Purpose Taps . . . and 7 new basic *and conversion* sets of Taps and Dies, handsomely boxed), Dies, Reamers, Cutters, End Mills, Counterbores and Countersinks.

2 AMPLE STOCKS: Your Morse-franchised Distributor is ready to supply you with the Morse Quality Cutting Tools you need. *New Morse methods of production, inventory control and expediting put him in a far stronger position in '53 than ever before.*

3 ON-THE-JOB EXPERIENCE: Your Morse-franchised Distributor knows his way around on cutting-tool applications, to give you *increased* production and *reduced* costs.

4 CLOSE CO-OPERATION FROM MORSE ENGINEERS: On any "cranky" or special problem, your Morse-franchised Distributor can immediately summon the help of Morse's top technical men.

5 PROVEN RESPONSIBILITY: Your Morse-franchised Distributor is a respected member of your business community. You can have full confidence, *as Morse has,* in him and his men.

THAT'S WHY IT'S ALWAYS GOOD BUSINESS TO
"CALL YOUR MORSE-FRANCHISED DISTRIBUTOR"

MORSE TWIST DRILL & MACHINE COMPANY, NEW BEDFORD, MASS.
(Division of VAN NORMAN CO.)
Warehouses in New York, Chicago, Detroit, Houston, San Francisco

ACTION!

problem . . .

MORSE

Cutting Tools

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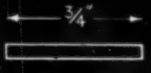

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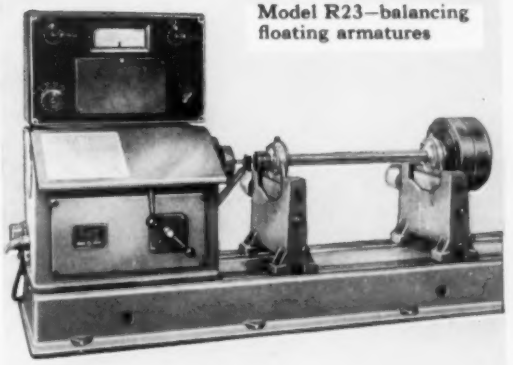
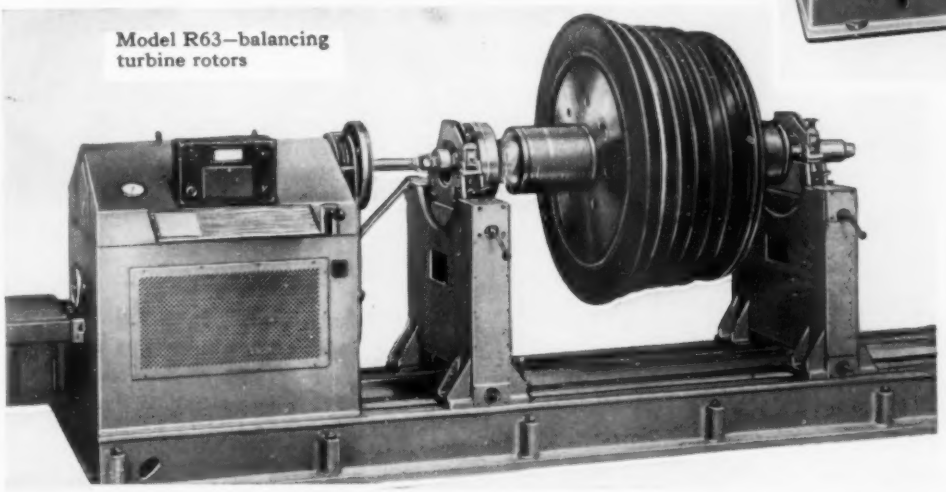


Model R23—balancing floating armatures



Model R63—balancing turbine rotors

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Machine Type	R63	R73	R83	R93
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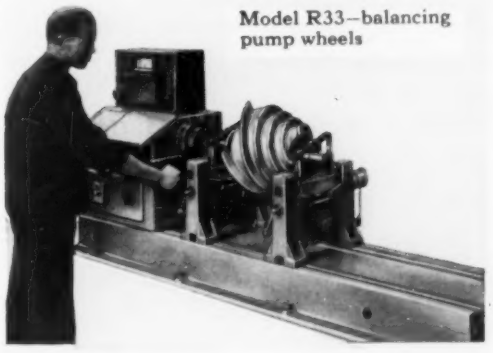

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Aesop's Fable of

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carries a moral for Cutting Fluid users

The Fable . . .

A Crow, sitting on a fence post, watched a huge Eagle swoop down on a luckless lamb and carry it away. "That looks easy", thought the Crow, and straightaway tried to duplicate the Eagle's feat. Of course, he couldn't lift the lamb and, instead, got tangled up in its wool and couldn't get loose. The farmer came over, grabbed the Crow, and wrung its foolish neck.

The Moral . . .

Just as there was a big difference in abilities of, and results secured by, the Eagle and the Crow in the fable, so are there big differences in the abilities of basically different types of cutting fluids. Stuart Oil Co., recognizing this, does not attempt to apply a watermixed cutting fluid where a straight oil is needed, or vice versa. Some applications require a fluid with great *lubricity*, on others high *anti-weld* properties are necessary. All require *temperature regulation*, but always *more than a "coolant" is needed.*

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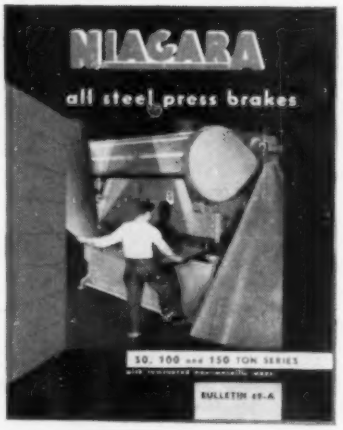
WRITE FOR BULLETIN 89



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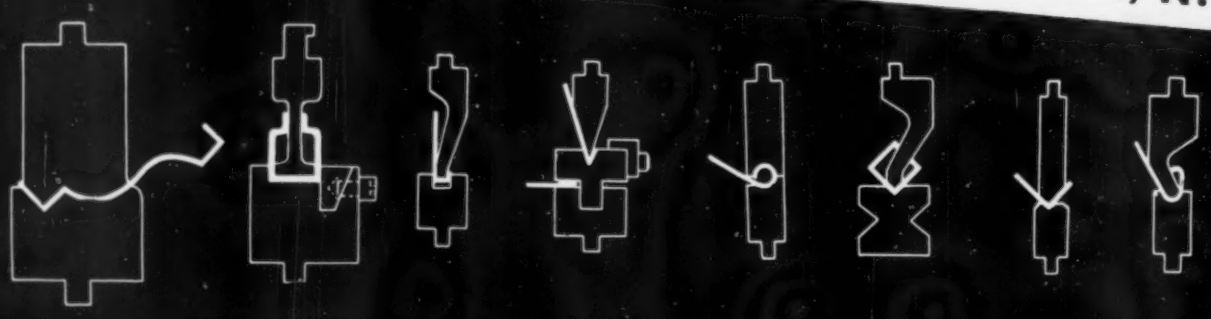

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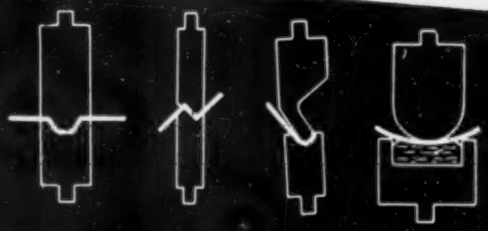

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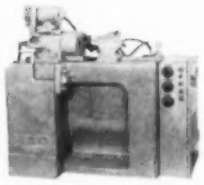

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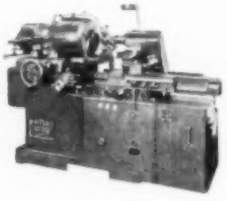

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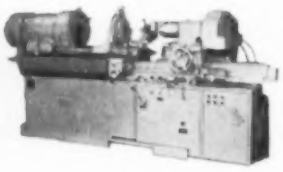
A general purpose hole grinder for tool room, small shop, or general production. Maximum traverse stroke, 20". Maximum grinding length, 8".



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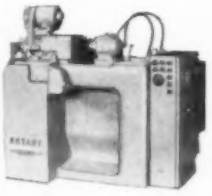
Specially designed for grinding bores in long work, such as machine tool spindles. Maximum traverse stroke, 20". Maximum grinding length, 8".



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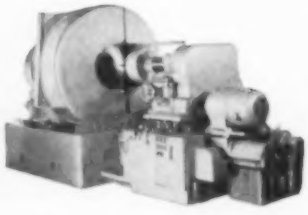
A fully automatic, high production machine for small and medium bore grinding. Max. traverse stroke, 6". Max. grinding length, 3".



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For production or single piece hole grinding on parts up to 60" diameter. Max. traverse stroke, 21". Max. grinding length, 16".

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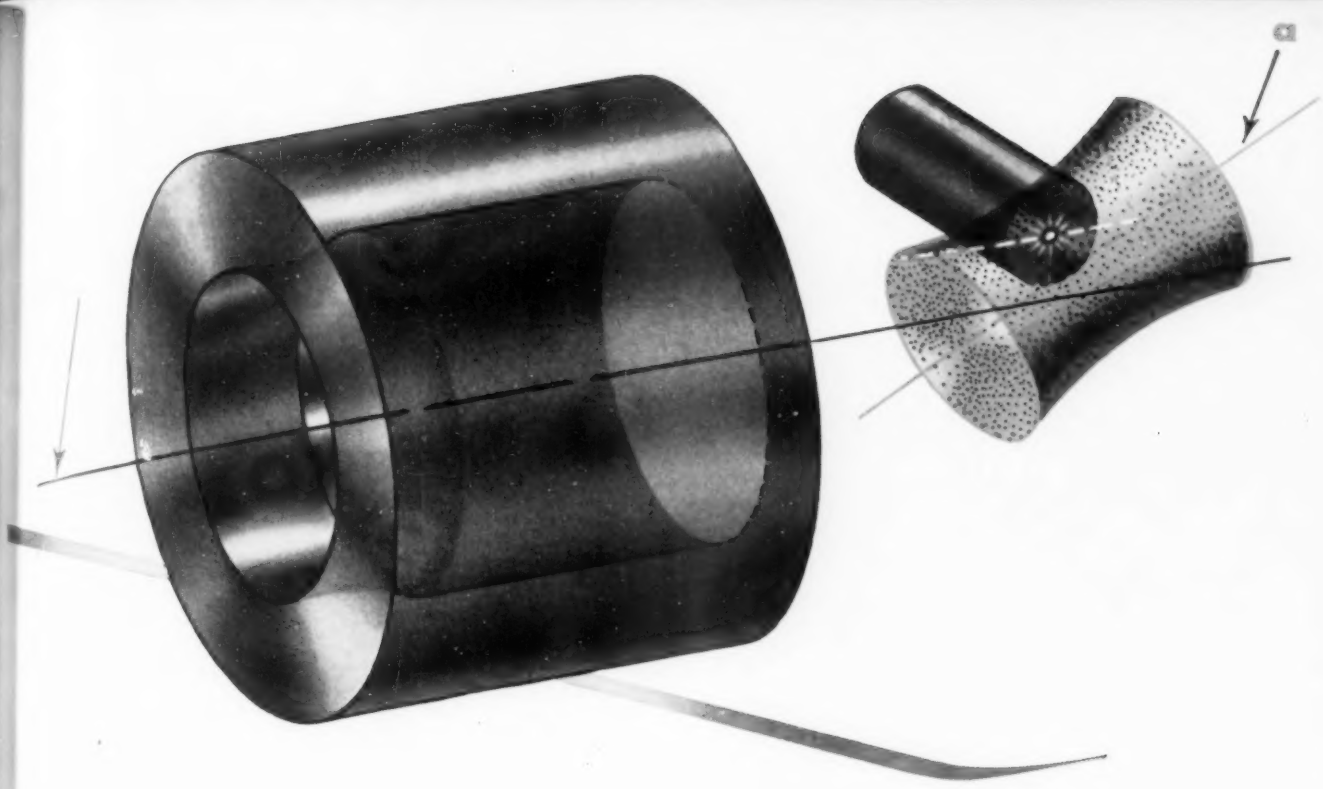

IT is generally believed in internal grinding that once the grinding wheel passes the diamond, the form of the wheel will be a perfect cylinder. In our illustration the wheel is tipped as it passes the diamond and an hourglass form is generated on the wheel. This condition is not peculiar to an internal grinder. The same form is generated in turning an O.D. on a lathe if the tailstock is either high or low.

The path of the diamond is a straight line across the surface of the wheel, but the wheel will not contact the work on the same straight line. Contact may be at a point on each end of the wheel. Since the wheel does not contact across its full face, wheel wear will be excessive and the wheel will act soft.

The geometry of the hole may be upset as in the illustration, with the result that the back of the hole will be tight. Neither turning the workhead nor changing the length of traverse will correct this error. Because the wheel is contacting at either one or two points, instead of a straight line, the surface finish will be poor. The remedy is to correct the alignment by bringing the wheel center line "a" parallel with the path of the wheel and in plane with the work center line "b".

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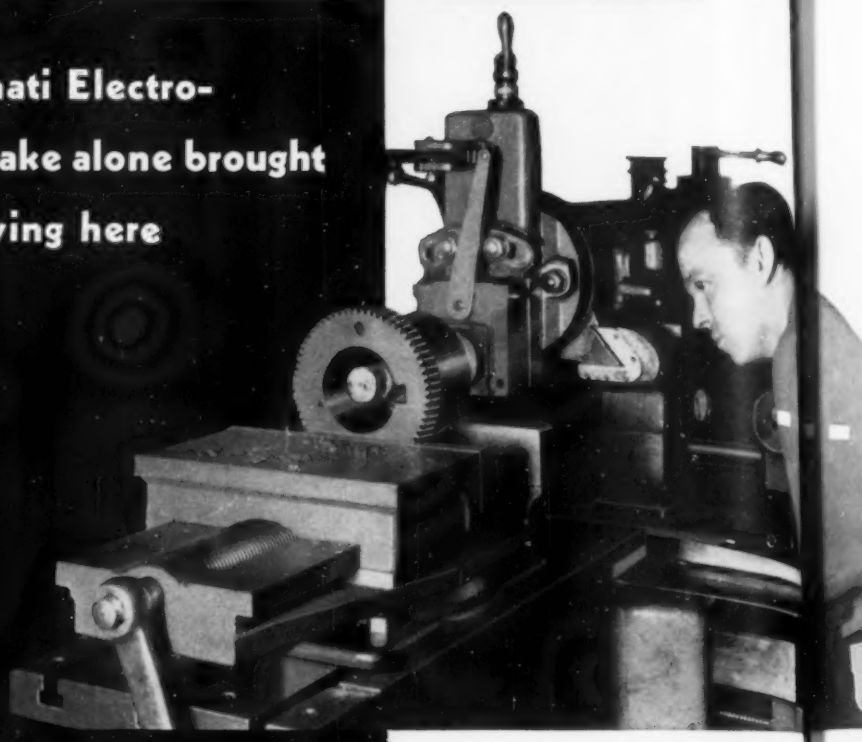

The New Cincinnati Magnetic Clutch and Brake, with its single, convenient control lever, gives the operator the fastest, simplest and most accurate control of his Shaper and converts waste time into productive time.

This powerful clutch and brake requires no adjustment, and has a long, maintenance-free life.

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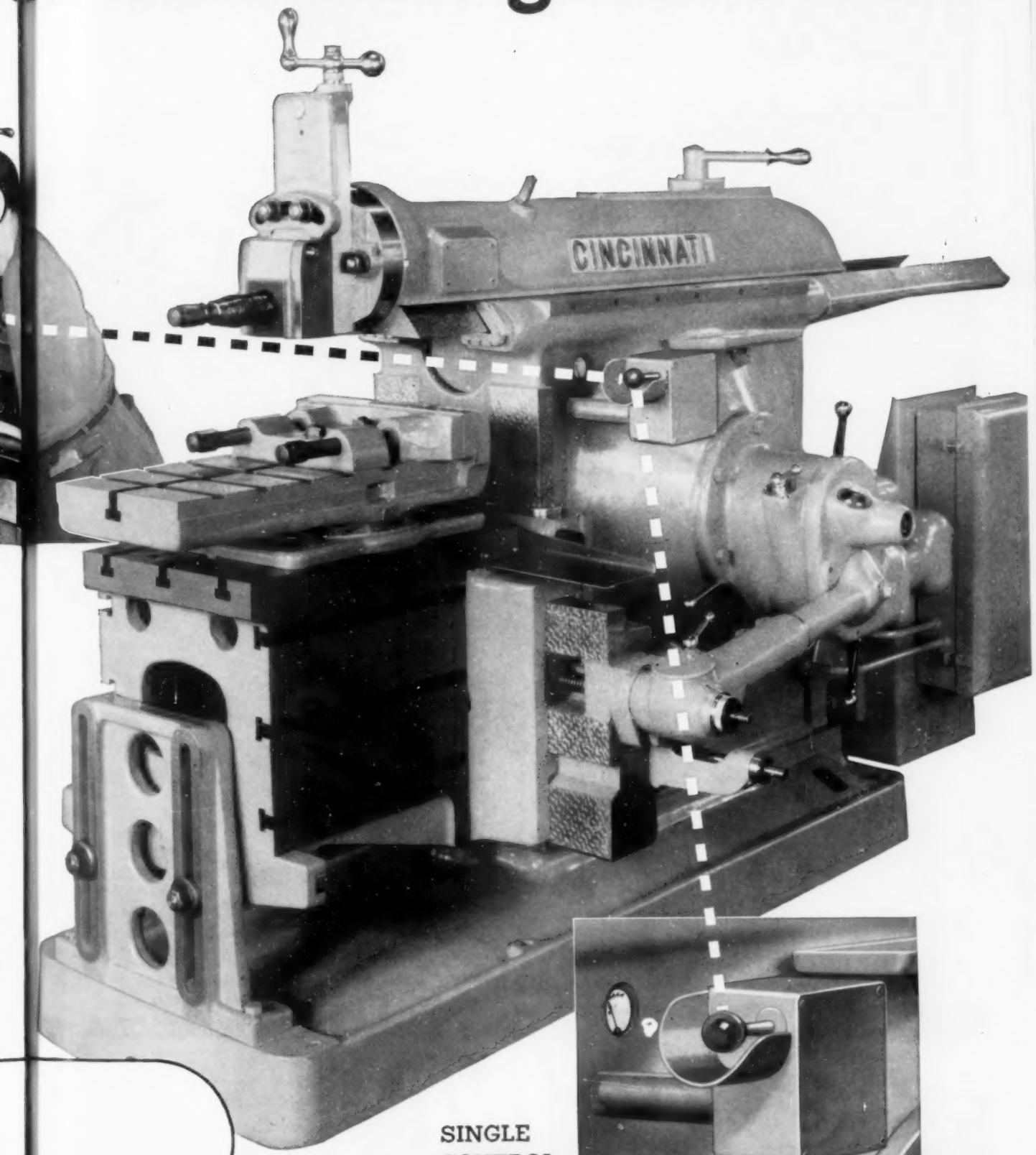

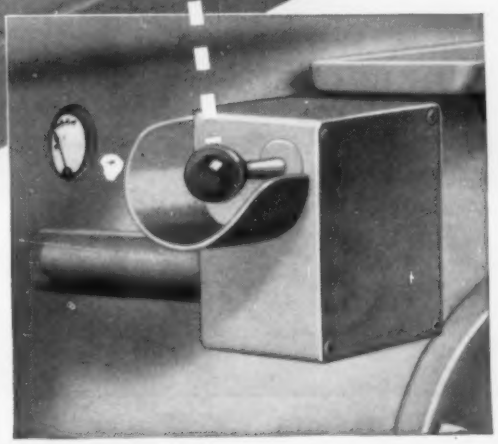

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for much longer engine wear— at much lower cost

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As a result engine builders, hoping to abolish the need for liners, experimented with various hard alloy irons that can furnish desired hardness in the cylinder bores.

However, these hard castings were extremely difficult to machine, and they cost several dollars per casting extra.

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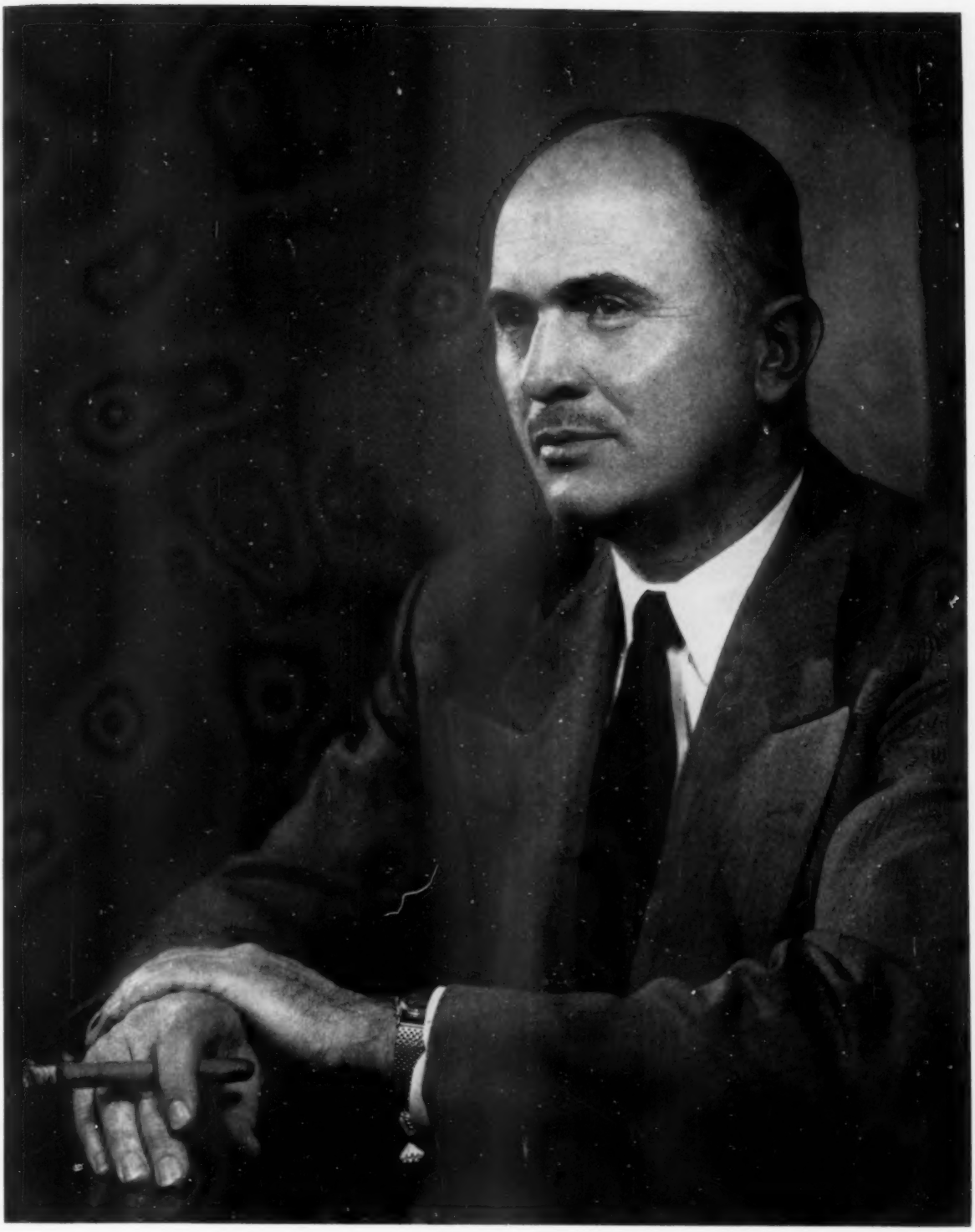

R F Waindle

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(Story on page 101)

Mills, Drills, Spotfaces and Taps Bearing Blocks

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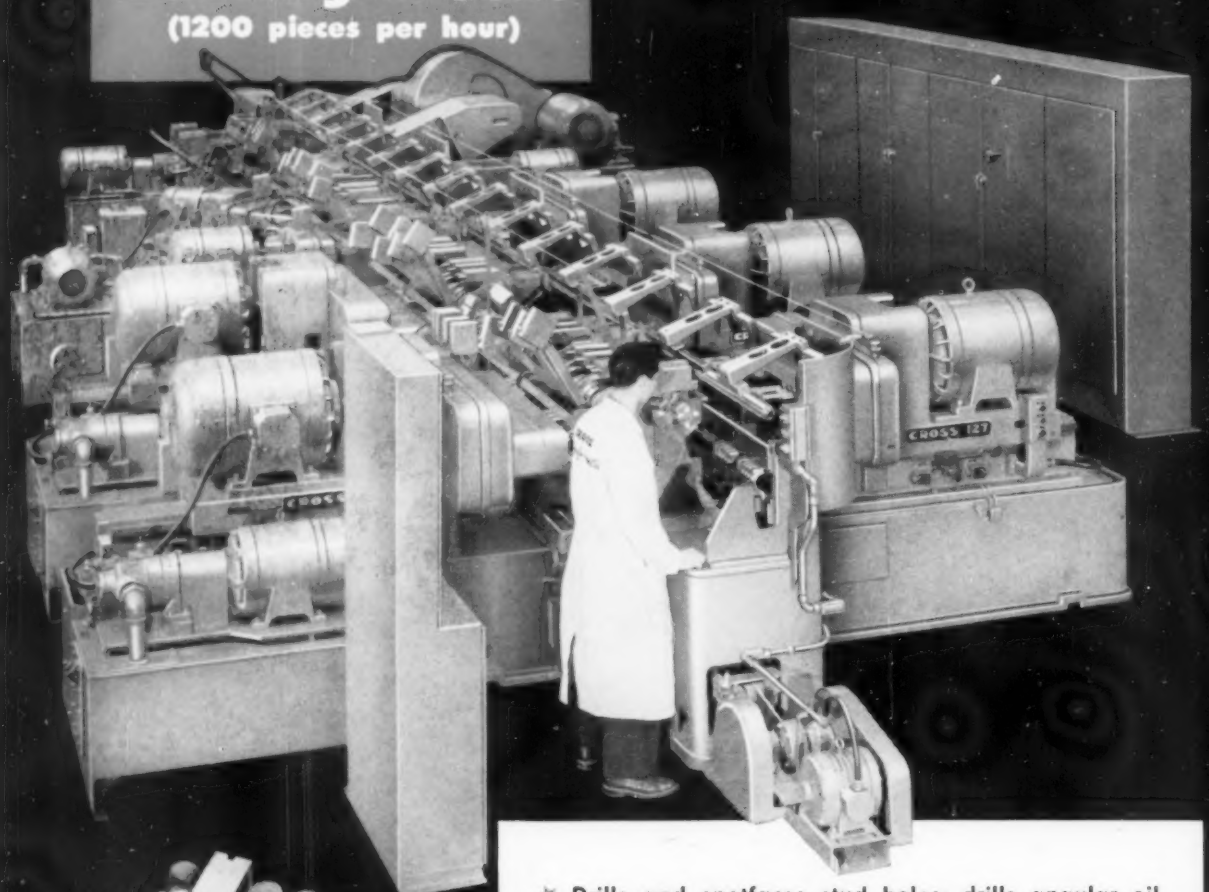

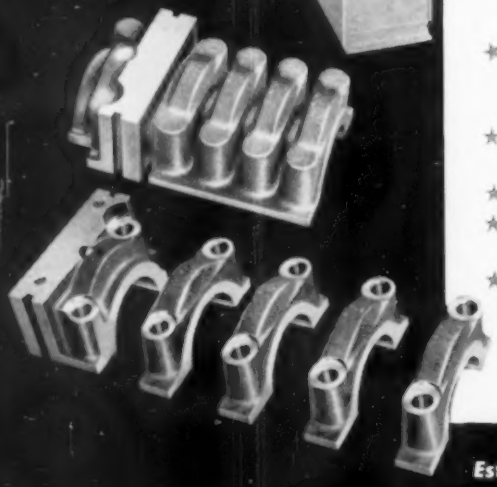

- ★ Drills and spotfaces stud holes; drills angular oil hole; drills and taps two screw holes; mills bearing lock slots; and saws into five individual pieces.
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- ★ Capacity for machining two sets of parts at a time.
- ★ Two heavy-duty, 25 hp, vee belt drive, milling spindles for sawing operations.
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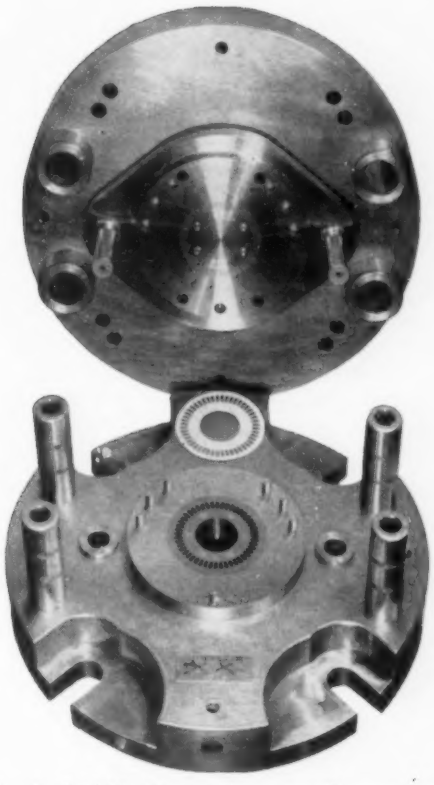


Fig. 1. Carbide die set for a small motor rotor stamping. Proper maintenance can extend the useful life and production of this set.

ONE OF THE IMPORTANT PROBLEMS of industry is to find ways and means of maintaining or improving quality and at the same time reducing the cost of a product. In this connection maintenance of machining tools, such as dies, molds, milling cutters, drills, etc., and the related machine tool equipment, plays an important part. To insure best results from tool and equipment investment and its contribution to final product cost, it is necessary to understand and carefully plan control of the relative operating failures and shortcomings.

All manufacturing concerns, in one form or another, plan ways to improve tool and equipment operating conditions and to control maintenance and repair cost in the interest of bettering product cost, quality and delivery. There are several ways and degrees of accomplishing this. The most common is to depend chiefly upon regular toolroom and production supervisory personnel to maintain control by personally following many individual detail tools, equipment and operating failures and shortcomings. At the same time they attempt to handle their part of major problems of production planning, cost, quality, and labor relations.

Of course everyone appreciates the need for aiding the foremen and, accordingly, has added manufacturing engineers or specialists of various kinds to cope with manufacturing problems. Such personnel is necessary but, instead of allowing them to develop into trouble-shooters, as is often the case, a plan similar to that in use at Westinghouse can provide data which, when properly used, will aid as a preventive rather than a cure. Also as conditions resulting in tool and equipment failures or shortcomings are reduced or eliminated, both manufacturing engineers and tool and equipment specialists will be afforded more time to apply their efforts to their rightful job of improving basic manufacturing conditions and methods.

However, it is becoming increasingly difficult for supervision to control tool and equipment operating performances, and management's assistance both in personnel and system should be more gainfully applied. Accordingly, Westinghouse in cooperation with its various divisions, developed a plain of maintenance expense control which is proving feasible for the foremen to use. The program provides basic information which can be used

---

*** Abstracted from paper 21T6, "Maintenance Expense Control of Production Tools and Equipment," presented before the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society Headquarters.**

† Senior member ASTE Pittsburgh chapter.

to improve product quality and cost as well as reduce tool failures, defective work, production losses, and delays. At the same time, beneficial effects are obtained by reducing the number of setups and machine down time.

Such a plan has been developed for application to tools and equipment in the following important classes:

1. Metal stamping, forming and punch presses.
2. Miscellaneous machining (milling, drilling, tapping, reaming, gear hobbing, etc.)
3. Hot pressing, hot forging and permanent molding, plastic molding and die casting.

Maintenance Expense Control Plan: The method of approach is basically the same for all tools but since punch press, metal stamping, and forming tools such as shown in *Fig.* 1 represent the largest dollar investment of any class of tools

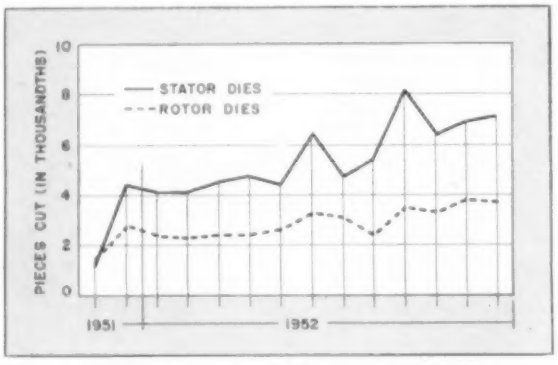


Fig. 2. Die performance chart for the number of stampings produced per 0.001 inch of die life.

used at Westinghouse, application of the plan was made to this group first.

In 1951 Westinghouse spent approximately 27 million dollars for maintenance, repair and renewal of dies, cutting tool, jigs, fixtures, molds, etc., and related machine tool equipment. Such figures might tend to make some feel that they are not in this class. Such thoughts should be dispelled. The important thing is that, to a large or small operation, the cost for an hour of production should be the gage and, generally speaking, the large and small companies are not too far apart in this respect and have the same common causes for excessive cost. Practically the same remedies apply to both large and small operations.

The plan has as its prime object, simplification of the means of finding conditions which cause tool and equipment failures that tend to result in manufacturing difficulties. Also it provides a set of recommended corrective measures to obtain improvement in the quality of die repair and resultant stamping performance. Many manufacturing problems are caused by supervision having lost contact with detail failures. Therefore it is necessary to emphasize their character and severity and to apply methods for controlling them.

What the Plan Will Do: It will give a complete history on individual tool performance, number of pieces produced between repairs, number of hours of repair, amount ground off a die and why the tool is being repaired. The records will also show the number of times a tool was used over a given period of time and favorably influence the control of setups.

Since longer runs, reduced failures and less maintenance are all instrumental in lowering cost, increasing production and improving quality, the following will serve to illustrate some of the effects of the cooperative action that develops as a result of the application of the plan.

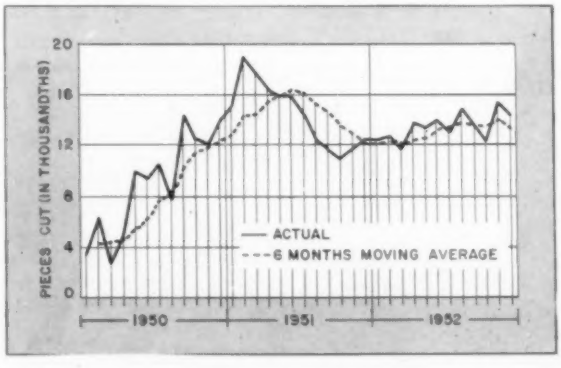
Die Life: Increased output per 0.001 inch of die life, as shown in *Fig.* 2, is the direct result of the operation of this plan. The solid line indicates how application of the plan improved stamping performance approximately 450 percent for a stator punching. The dotted line shows the rotor stamping production increased 135 percent.

An analysis of the reasons for the variance indicated that the principal reasons for the poor showing of the rotor die were due to faulty stripper design and too light a press. The design of the stripper was changed to better heat-treated material and a closer fit to the punches, thereby aiding materially as a guiding agent during the punching operation and entry of the punch into the die. New presses have been ordered.

All other things being equal, the performance will eventually be approximately the same for both dies. Cutting edges for both are the same material and have the same heat treatment. When properly supported and guided, they should act nearly alike in cutting performance.

When building a die an attempt is made to put material into the cutting edge that, when properly treated and constructed, will produce a satisfactory quantity and quality of stampings. A steel die costing $6,000, or a tungsten carbide die costing $12,000 to $15,000, having useable die life of one inch costs $6 for each 0.001 inch ground off the steel die

Fig. 3. Number of stampings produced per hour of repair on lamination dies.



and $12 to $15 for each 0.001 inch ground off the tungsten carbide die.

Pieces per Hour of Repair: Too long a run resulting in an excessive number of pieces per 0.001 inch of die life can be harmful and can cause unnecessary die repair cost because excessive wear or chipping can occur or, in extreme cases, die breakage may result. Accordingly, emphasis should be placed on economical runs rather than long runs. *Fig.* 3 shows a case where the number of pieces per hour of repair has been increased.

When both increased production per 0.001 inch of die life and per hour of repair is accomplished, then the dollar cost per productive hour of relative metal stamping has been reduced. A typical example of such accomplishments is shown in *Fig.* 4.

The organization of personnel required to administer a program of this type varies, depending on the size and complexity of the metal-stamping operation in question. Usually this can be accomplished by forming a Tool and Die Committee with a chairman and a die specialist, thoroughly trained and familiar with tool construction and application problems involved and with sufficient time and responsibility to collect and analyze information relative to the frequency and severity of tool and equipment failures. In this connection, the die specialist acts as liaison between the press operating, die maintenance, die design and other activities. Aiding in maintaining records and keeping chairmen informed, he also acts as secretary at meetings held periodically. Responsible persons from production, tool design, tool construction and maintenance, quality control, and product design engineering are invited for the purpose of discussing causes of failures attributed to their respective activity.

Applying the Plan: The principal factors involved when applying the plan to any type of tool or equipment are: design of product; suitability of machine tool equipment; type, design and construction of tools, dies and equipment; and setup, operation and maintenance of tools, dies and equipment. It is imperative that both the supervisory and engineering personnel thoroughly understand the responsibilities, problems, and mutual interests involved in controlling these factors and for that reason they will be discussed in detail.

Design of Product: With respect to the design of a metal stamping, these questions must be answered: How does it tie in with the other three factors and what is the possible effect of the design on product cost and quality? The general requirements are that the product design engineer must

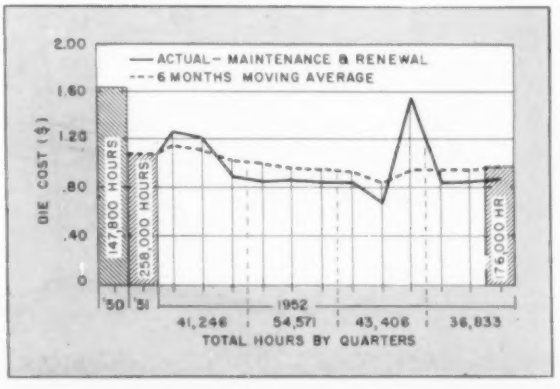
1. Check with sales and obtain a reasonable indication of annual activity required.
2. Be able to tell the manufacturing tool design people the approximate life of the design.
3. Check with manufacturing personnel as to whether or not the shape of the stamping and its material will permit practical stamping operation. Often close tolerances on sharp or complicated bends or draws finally require extra sizing operations and excessive die maintenance to an extent that forging, casting, hot pressing or two or more simple stampings welded together and sized would be a better method. In such cases the design engineer and manufacturing people should discuss the relative values of metal stampings and other methods of forming.
4. Design part so as to reduce material scrap loss to a minimum; first, by using standard materials, second, by using a minimum of material to make the stamping.
5. Cooperate with the tool people in the interest of providing a product design that will require a minimum of future design and tool changes.

Suitability of Machine Tool Equipment: Machine tool equipment is always an important factor and suitability and availability must be considered cooperatively by all concerned because of its possible effects on product cost and quality. Before deciding to use existing equipment check to see if the market has anything better to offer.

Type, Design and Construction of Die: These factors must be analyzed carefully if the most satisfactory production is to be achieved. The evaluations involve:

1. Type of Die: If the design of the product and the suitability of machine tool equipment have been carefully evaluated and the stamping design is suitable, then the uncertainty on the part of the die designer as to the general type of die required will be reduced to a minimum.
2. Design of Dies: Usually it is difficult to predict even approximately the annual activity and the life expectancy of a stamping design. Nevertheless it is important that this be taken seriously.
3. Construction of Die: The actual construction of the die must be aided by tool design information that will permit punch and die parts to be made of materials that, when properly heat treated and ground, will have cutting edges giving the best possible properties of resisting abrasion, shock, impact and bend requirements of the stamping operation in question. Also correct materials, hardness and tolerances in all parts

Fig. 4. Die cost per press net allowed hours for general types of dies.



supporting the cutting edges should be employed in order to maintain a maximum degree of alignment and control of clearances between punch and die.

SETUP, OPERATION AND MAINTENANCE OF DIE: Since the quality and quantity of product depends to some extent on the successful operation of the dies and equipment the following must be given careful consideration:

1. Ample press capacity.
2. Adequate press alignment and maintenance.
3. Careful die setting.
4. Application of safety guards and measures.
5. Proper placing or ejection of stampings in or from die.
6. In case of progressive dies, suitable feeding and piloting of material.
7. Adequate facilities for servicing, such as grinding, and minor adjustments and repairs that will permit maintaining maximum die performance values.
8. Stocking of standardized replacement parts to minimize press down time in case of repairs.
9. Reduction or elimination of all conditions contributing to die run stoppages that prevent accomplishment of economical runs.

Having carefully studied the principal factors involved, it is then necessary for the Die Committee to determine the conditions and causes of die run stoppages peculiar to its line of activity. For example, in *Fig.* 5 twenty-one conditions are shown as whole numbers. Causes contributing to respective conditions are shown as .1, .2, .3, etc. Of course, they are not all common or frequently occuring; nevertheless, in some instances it takes only one of these conditions to seriously damage a die. For example, miscut, slugged die, broken punch, broken or bent stripper, etc.

TOOL DIE RECORD TAG: The actual operation of the plan is then carried on as follows: The tag shown

Fig. 5. Card for identifying key number for condition and reason for die failure.

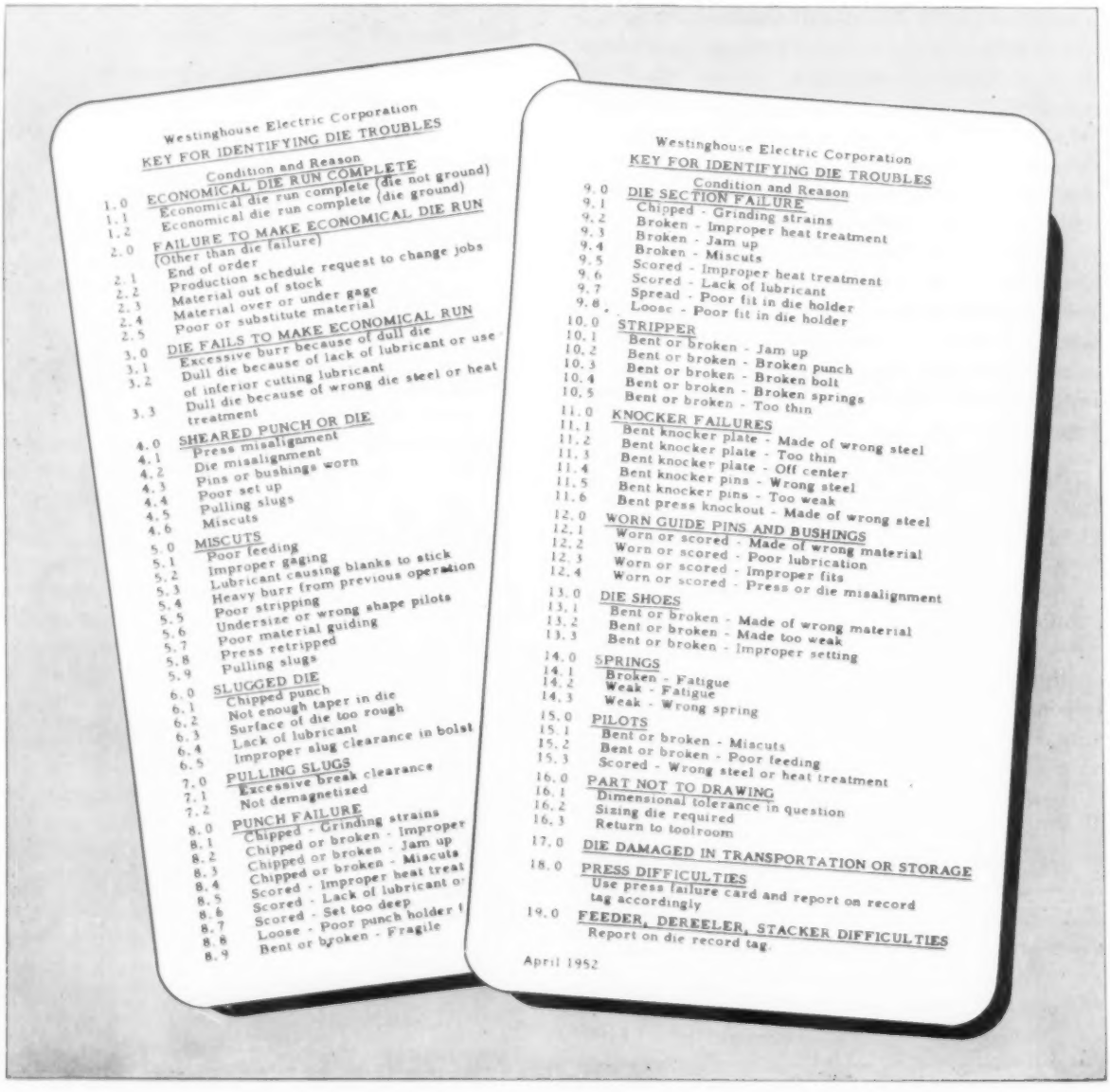

Westinghouse Electric Corporation
KEY FOR IDENTIFYING DIE TROUBLES
Condition and Reason
1.0 ECONOMICAL DIE RUN COMPLETE
1.1 Economical die run complete (die not ground)
1.2 Economical die run complete (die ground)
2.0 FAILURE TO MAKE ECONOMICAL DIE RUN (Other than die failure)
2.1 End of order
2.2 Production schedule request to change jobs
2.3 Material out of stock
2.4 Material over or under gage
2.5 Poor or substitute material
3.0 DIE FAILS TO MAKE ECONOMICAL RUN
3.1 Excessive burr because of dull die
3.2 Dull die because of lack of lubricant or use of inferior cutting lubricant
3.3 Dull die because of wrong die steel or heat treatment
4.0 SHEARED PUNCH OR DIE
4.1 Press misalignment
4.2 Die misalignment
4.3 Pins or bushings worn
4.4 Poor set up
4.5 Pulling slugs
4.6 Miscuts
5.0 MISCUTS
5.1 Poor feeding
5.2 Improper gaging
5.3 Lubricant causing blanks to stick
5.4 Heavy burr from previous operation
5.5 Poor stripping
5.6 Undersize or wrong shape pilots
5.7 Poor material guiding
5.8 Press retripped
5.9 Pulling slugs
6.0 SLUGGED DIE
6.1 Chipped punch
6.2 Not enough taper in die
6.3 Surface of die too rough
6.4 Lack of lubricant
6.5 Improper slug clearance in bolst
7.0 PULLING SLUGS
7.1 Excessive break clearance
7.2 Not demagnetized
8.0 PUNCH FAILURE
8.1 Chipped - Grinding strains
8.2 Chipped or broken - Improper
8.3 Chipped or broken - Jam up
8.4 Chipped or broken - Miscuts
8.5 Scored - Improper heat treat
8.6 Scored - Lack of lubricant o
8.7 Scored - Set too deep
8.8 Loose - Poor punch holder f
8.9 Bent or broken - Fragile
Westinghouse Electric Corporation
KEY FOR IDENTIFYING DIE TROUBLES
Condition and Reason
9.0 DIE SECTION FAILURE
9.1 Chipped - Grinding strains
9.2 Broken - Improper heat treatment
9.3 Broken - Jam up
9.4 Broken - Miscuts
9.5 Scored - Improper heat treatment
9.6 Scored - Lack of lubricant
9.7 Spread - Poor fit in die holder
9.8 Loose - Poor fit in die holder
10.0 STRIPPER
10.1 Bent or broken - Jam up
10.2 Bent or broken - Broken punch
10.3 Bent or broken - Broken bolt
10.4 Bent or broken - Broken springs
10.5 Bent or broken - Too thin
11.0 KNOCKER FAILURES
11.1 Bent knocker plate - Made of wrong steel
11.2 Bent knocker plate - Too thin
11.3 Bent knocker plate - Off center
11.4 Bent knocker pins - Wrong steel
11.5 Bent knocker pins - Too weak
11.6 Bent press knockout - Made of wrong steel
12.0 WORN GUIDE PINS AND BUSHINGS
12.1 Worn or scored - Made of wrong material
12.2 Worn or scored - Poor lubrication
12.3 Worn or scored - Improper fits
12.4 Worn or scored - Press or die misalignment
13.0 DIE SHOES
13.1 Bent or broken - Made of wrong material
13.2 Bent or broken - Made too weak
13.3 Bent or broken - Improper setting
14.0 SPRINGS
14.1 Broken - Fatigue
14.2 Weak - Fatigue
14.3 Weak - Wrong spring
15.0 PILOTS
15.1 Bent or broken - Miscuts
15.2 Bent or broken - Poor feeding
15.3 Scored - Wrong steel or heat treatment
16.0 PART NOT TO DRAWING
16.1 Dimensional tolerance in question
16.2 Sizing die required
16.3 Return to toolroom
17.0 DIE DAMAGED IN TRANSPORTATION OR STORAGE
18.0 PRESS DIFFICULTIES
Use press failure card and report on record tag accordingly
19.0 FEEDER, DEREELER, STACKER DIFFICULTIES
Report on die record tag.
April 1952

Fig. 6. Tool die record tag attached to die shows history of die.

in *Fig.* 6 is put into operation and information is recorded on it. At the start of every die run a record tag is attached to the die and at various stages during the die operation or repair the various spaces are filled in, in the following sequence.

1. Department, tool number, type of die, drawing and item or style number of part.
2. Press number, material specification number and thickness, date die is set in press.
3. Piece count at the end of run.
4. In case of costly dies show amount ground from punch and die.
5. In all cases where the die is repaired, show number of hours and by whom repaired.
6. Under reasons for stopping die run, show the code number (from *Fig.* 5) of each condition and relative cause that contributed to the stoppage of the die run.
7. If after repairing, the die is ready to return to the press the tag is lifted by the foreman and filed and a new tag attached.
8. In case of "End of Order," and the die is returned to crib, the card is lifted, signed and filed. A new card is not attached until a future run.

Responsibility for filling in the card will vary; however, as a rule, die setters, die repairmen, inspection and foremen will be used depending upon the nature and size of operation in question.

During the early stages of introducing the plan it is advisable to inform die setters, press operators, die makers and equipment maintenance men that the object of the plan is to determine the frequency and severity of conditions causing die run stoppages for the purpose of taking corrective action to reduce or eliminate them and their adverse effects on operating conditions, production deliveries, quality and cost of products. In this connection to aid in filling in the tag, a printed form (*Fig.* 5,) of Conditions and Reasons, encased in transparent plastic, is provided for die setters, die makers, maintenance men and responsible supervisors.

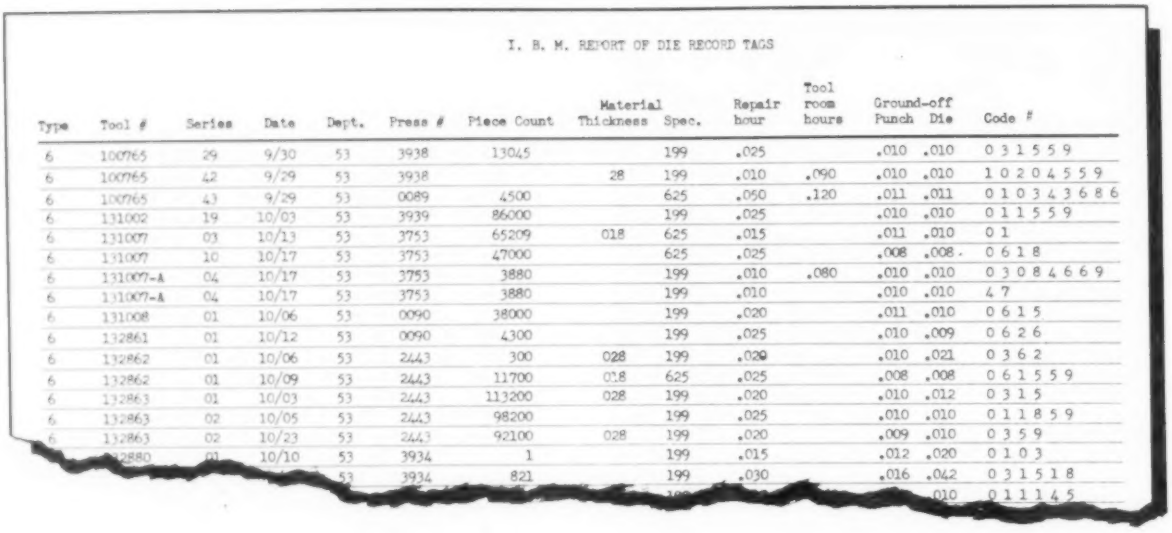
The importance of correctly and completely filling in the tag can be appreciated if it is realized that with respect to:

1. *Press number:* A specific die may work well in one press and not in another.
2. *Kind of material:* A die used for brass may not cut copper with the same burr effect.

CAUSES OF DIE RUN FAILURES
TOTAL OCCURRENCES MONTH BY MONTH

Col. #1 Code #	Col. #2 Condition & Reason	Col. #3 Monthly Average Prev. Yr.	Col. #4 Jan.	Feb.	Mar.	Apr.	May	June	Col. #5 Mo. Ave. 6 Month Period
1.0	Economical die run complete.								
1.1	Economical die run complete (die not ground).	25	29	26	34	31	29	37	31
1.2	Economical die run complete (die ground).	17	16	17	11	12	8	9	12
	Total	42	45	43	45	43	37	46	43
2.0	Failure to make economical die run (other than die failure).								
2.1	End of order	15	18	16	12	14	7	6	12
2.2	Production schedule request to change jobs.	11	8	4	3	0	0	1	2.7
2.3	Material out of stock	4	3	3	5	2	1	0	2.3
2.4	Material over or under gage.	9	10	12	14	8	6	3	8.8
	Total	8		8					

Fig. 7. Monthly record of die run failures for Method 1.



I. B. M. REPORT OF DIE RECORD TAGS

Type	Tool #	Series	Date	Dept.	Press #	Piece Count	Material Thickness	Material Spec.	Repair hour	Tool room hours	Ground-off Punch	Ground-off Die	Code #
6	100765	29	9/30	53	3938	13045		199	.025		.010	.010	0 3 1 5 5 9
6	100765	42	9/29	53	3938		28	199	.010	.090	.010	.010	1 0 2 0 4 5 5 9
6	100765	43	9/29	53	0089	4500		625	.050	.120	.011	.011	0 1 0 3 4 3 6 8 6
6	131002	19	10/03	53	3939	86000		199	.025		.010	.010	0 1 1 5 5 9
6	131007	03	10/13	53	3753	65209	018	625	.015		.011	.010	0 1
6	131007	10	10/17	53	3753	47000		625	.025		.008	.008	0 6 1 8
6	131007-A	04	10/17	53	3753	3880		199	.010	.080	.010	.010	0 3 0 8 4 6 6 9
6	131007-A	04	10/17	53	3753	3880		199	.010		.010	.010	4 7
6	131008	01	10/06	53	0090	38000		199	.020		.011	.010	0 6 1 5
6	132861	01	10/12	53	0090	4300		199	.025		.010	.009	0 6 2 6
6	132862	01	10/06	53	2443	300	028	199	.029		.010	.021	0 3 6 2
6	132862	01	10/09	53	2443	11700	018	625	.025		.008	.008	0 6 1 5 5 9
6	132863	01	10/03	53	2443	113200	028	199	.020		.010	.012	0 3 1 5
6	132863	02	10/05	53	2443	98200		199	.025		.010	.010	0 1 1 8 5 9
6	132863	02	10/23	53	2443	92100	028	199	.020		.009	.010	0 3 5 9
6	132880	01	10/10	53	3934	1		199	.015		.012	.020	0 1 0 3
				53	3934	821		199	.030		.016	.042	0 3 1 5 1 8
												.010	0 1 1 1 4 5

Fig. 8. Method 2 for recording die failures tabulated on a calculating machine.

3. *Thickness of material:* A die made for 1/32 inch will not cut 3/32 inch to good advantage.
4. *Amount ground from die and punch:* Dies costing $500, $1,000, $5,000, $10,000, etc., having one inch of useable life cost $.50, $1.00, $5.00, $10.00, respectively per 0.001 inch ground off die.
5. *Hours of Repair:* The value of recording the number of hours of repair needs no emphasizing.
6. *Code numbers:* A foreman should know as much as possible about causes of stoppages. Therefore, when signing he can easily recognize by the code number things he would otherwise probably not know.

COLLECTION OF TAGS: Each day or at suitable periods the committee's liaison man visits each punch press department and collects the tags. While in the department he checks for errors or lack of information. This action is particularly important in the early stages of the introduction of the plan. First, occasional difficulty is experienced by the die setter or die maker in deciding the cause of failure. Second, personnel realize that supervision not only has a mutual interest but is also lending a helping hand to correct conditions otherwise often overlooked. Tags are next filed by tool number in sequence in readiness for the monthly tabulation.

TABULATING TAGS: Tabulating data from the record tags can be done in several ways; however, the number of tags per month and available tabulating systems will determine the method used. Plans used at Westinghouse are:

Method 1: For an activity of approximately 600 tags a month a form, *Fig.* 7, is used for recording condition, reason and total number of stoppages monthly. The code number (Column 1) and description (Column 2) on this form are identical with those on the plastic card shown in *Fig.* 5. Column 3 shows the monthly average for the year previous. Column 4 represents monthly totals showing trend and column 5 the current six months' average for comparison with the previous year.

Method 2: For an activity of approximately 600 or more tags a month a form, *Fig.* 8, is used in place of form in *Fig.* 7. This form is made up on a tabulating machine. Column 1 indicates the type of a die to tie in with economical run values that have been established for various types. Column 2 indicates the die number. Column 3 indicates the number of the die when there is more than one die of a given tool number. The balance of the headings are self-explanatory. That is piece number, piece count, etc.

Method 3: Method 3 is used in connection with either Method 1 or 2 in cases where the die record tags indicate poor performance of specific individual dies and it is desired to get a history for a period of time. Then a form, *Fig.* 9, is used. Since this form permits recording practically all information that may be required on the lowest priced dies as well as dies costing thousands of dollars where the die wear becomes an important factor it is necessary to fill in only such data as required to make necessary improvements.

Code numbers listed indicate the reasons for stopping die run. Material width, thickness and specification of material actually stamped is necessary to compare with the size and material the die was designed to punch, and where serious changes are made, corrective action should be decided on. In this connection consideration is being given to marking the material information on the die so that the die setter may question the use of excessively oversize material.

The failures as shown on *Figs.* 7, 8, and 9, are periodically reviewed by the Die Committee and other interested persons and action decided upon to reduce to a minimum all cases of stoppages.

Analysis of Records: Whether Method 1, 2 or 3 is used, the object is still to determine, from the recorded information: (1) Those conditions causing stoppages whose frequency and severity give cause for analysis and corrective action. (2) Those types of dies that have characteristic failings requiring a study of die construction, die materials and heat treatments, material being punched, press conditions, etc. (3) Individual dies that require too many hours of repair or whose die runs are too short causing too many setups and excessive press down time or subject to excessive die dullness requiring grinding and resultant loss of die life. From such analysis and corrective actions, economical performance values are established for use as a guide in controlling future performance. Also, die design standards may be established as a further aid and, finally, adequate press, feeder, dereeler, and stacking facilities may be provided as an aid in protecting the die construction and in facilitating safe and economical performance.

expectancy values for the number of cuts or impressions that blanking, piercing (shear action), bending, or draw dies should normally produce under proper die construction, material and press operating conditions. Metal stamping activities at Westinghouse, like many other companies, have brasses, copper, aluminum, hot rolled steel, cold rolled steel, electrical sheet, stainless and spring steels in varying degrees of hardness and in thicknesses, ranging from a few thousandths to one half inch. After careful study the first set of these values which have to date proven fairly accurate is shown in *Fig.* 10.

Despite the complexity of the problem which involved establishing a few common denominators to take the place of the many hundreds of material specification numbers used at Westinghouse, there are numerous material thicknesses, ranging from 0.002 to ½ inch and approximately 100 different types of dies. Nine basic types of material have been established as shown in *Fig.* 10.

DIE PERFORMANCE RECORD

Department: "X" Die # 2647 Type: #6 Series: #3

Die Designed for Material Tks. & Width 1/32 x 2" Spec. # 1593 C.R.S. Die Replacement Cost 3,000.00 $ per .001" of Die Life $ 3.00

Bogie: Pcs. per Run _____ Pcs. per Hour of Repair _____ Pcs. per 1/1000" Ground from Die

Press #	Date	Code #	Matl. Width & Thks.	Matl. Spec.	No. of Cuts per Run	Die Repair Hours	No. Pieces per Hrs. of Repair	Pieces per .001 Die	Pieces per .001 Punch	Punch & Die Life Inventory Ground Punch	Ground Die	Punch	Die	Inches
3934	6/10/52	4.2 - 8.1	1/32 x 2	1556	127	16	8	6	5	.020	.025			1.500
3934	6/18/52	5.1 - 8.4	1/32 x 2	1556	821	9.5	87	51	41	.016	.020			1.400
3934	6/24/52	3.1	1/32 x 2	1556	15,065	1.5	10,070	1,256	1,080	.012	.014			1.300
3934	7/ 2/52	6.1	1/32 x 2	1556	10,294	7.0	1,470	1,260	1,029	.008	.010			1.200
3934	7/10/52	4.1	1/32 x 2	1556	58	14.5	3	3	2	.016	.022			1.100
3938	7/23/52	1	1/32 x 2	1556	63,762	1.5	42,508	10,627	7,970	.006	.008			1.000
3938	7/29/52	3.1	1/32 x 2	1556	54,112	1.5	36,075	7,730	5,411	.007	.010			.9
3938	8/ 5/52	3.1	1/32 x 2	1556	59,760	2.75	21,790	11,952	8,537	.005	.007			.8
3938	8/14/52	2.3	1/32 x 2	1556	20,156	1.5	13,437	2,880	2,240	.007	.009			
3938	8/20/52	1.2	1/32 x 2	1556	80,100	1.5								
3938	9/ 3/52													

Fig. 9. Die performance record for an extended period where performance requires analysis.

Committee Action: The Die Committee deals with all conditions affecting the die operation. Accordingly, action is called for on presses, handling facilities, plating, cutting lubricants, material difficulties and production scheduling for the reason that they can seriously affect the quantity, quality and cost of the metal stampings. They also affect the safe operation of equipment.

As part of the plan to obtain efficient operating conditions, the Westinghouse Die Control Committees decided to run tests and collect data for the purpose of establishing economical die performance

In connection with the approximate 100 die names used at Westinghouse for the purpose of simplicity and a minimum sacrifice of accuracy, it was agreed to reduce same to three major die actions—shear, bend and draw.

Accordingly, with either *A* or *B* material graded as easy, medium or difficult to stamp and its thickness as thin, medium or thick, then—for shear, bend or draw operations—the thousands of stampings a die will normally produce are shown in *Fig.* 10.

Somewhat higher values are allowed for shear action with automatic feed. Likewise, a range of values for bending and drawing was established.

These values are proving to be reasonably accurate with some indications that it may be necessary to increase them in the near future.

Of course it must be realized that such values are for the general run of die operation where die construction and operation is not seriously affected adversely by extremely close tolerances of stamping, low burr allowances or fragile die construction. For such conditions special values must be assigned.

Corrective Actions: Once having determined that corrective action is necessary as a result of information obtained from the die performance record tag, then each specific case of stoppage or failure must be studied as to the cause, effect and action taken, *Fig.* 9.

Space does not permit illustrating all twenty major conditions in detail. Therefore, the case of sheared punch or die (item 4.0 in *Fig.* 5) will be used as a typical example. The term sheared is applied when the cutting edge of the punch or die is dulled or scored because of actual contact between the two cutting edges. Causes of shearing as listed on the key card, *Fig.* 5, are

- 4.1 Press misalignment.
- 4.2 Die misalignment.
- 4.3 Worn guide pins and bushings.
- 4.4 Poor setup.
- 4.5 Pulling slugs.
- 4.6 Miscuts.

Shearing of punch and die can result in excessive die wear and excessive burr on blank. If a die in this condition is permitted to operate too long it can cause chipping and finally be the direct cause of die spreading or punch or die breakage. Shearing due to die misalignment in time can cause press wear.

The corrective measures to be taken for each type of failure are

- 4.1 Adequate program of press inspection and maintenance.
- 4.2 Care in die repair and die setting.
- 4.3 Inspection periodically and replacement when necessary.
- 4.4 Die setters training program.
- 4.5 Check break clearance and, if necessary, replace punch, demagnetize die; avoid excessive lubrication on blanks.
- 4.6 Proper control of piloting, roll feeding, dereeling or stacking.

Fig. 10. Card giving key numbers for establishing die runs.

Key for Establishing
ECONOMICAL DIE RUNS

TYPE OF MATERIAL (Select Proper Type by Group & No.)

Group "A"	Group "B"
1. Aluminum	1. Steel C. R. S.
2. Brass	2. Steel H. R. S.
3. Copper	3. Steel, Electrical
4. Bronze	4. Steel, Stainless
	5. Steel, Spring

Group "C"	Group "D"
1. Celluloid	1. Felt
2. Cork	2. Neoprene Sheet
3. Micarta	3. Packing Sheet
4. Fish Paper	4. Packing and Rope
5. Fibre	

MATERIAL THICKNESS (Select Proper Size by Name)

Thin	Up to 1/16"
Medium	Over 1/16" to 1/8"
Thick	Over 1/8" to 1/2

MATERIAL GRADE (Select Proper Grade by Name)

Easy	Non-resistant to Cold Working
Medium	Semi-resistant to Cold Working
Difficult	Very resistant to Cold Working

SHEAR OPERATION USING HAND FEED

	Thickness	Grade	Group "A" in Thousands	Group "B" in Thousands
1.	Thin	Easy	90 to 120	70 to 100
2.	Thin	Medium	70 to 100	50 to 80
3.	Thin	Difficult	35 to 45	15 to 25
4.	Medium	Easy	60 to 90	40 to 70
5.	Medium	Medium	50 to 70	30 to 50
6.	Medium	Difficult	30 to 40	10 to 20
7.	Thick	Easy	45 to 60	25 to 40
8.	Thick	Medium	40 to 50	20 to 30
9.	Thick	Difficult	25 to 30	5 to 10

SHEAR OPERATION USING AUTOMATIC FEED

10.	Thin	Easy	120 to 170	100 to 150
11.	Thin	Medium	80 to 120	60 to 100
12.	Thin	Difficult	45 to 60	25 to 40

BENDING DIES

13.	Thin	Easy	145 to 170	125 to 150
14.	Thin	Medium	100 to 120	80 to 100
15.	Thin	Difficult	60 to 70	40 to 50
16.	Medium	Easy	120 to 145	100 to 125
17.	Medium	Medium	70 to 100	50 to 80
18.	Medium	Difficult	50 to 60	30 to 40
19.	Thick	Easy	100 to 120	80 to 100
20.	Thick	Medium	50 to 70	30 to 50
21.	Thick	Difficult	20 to 50	10 to 30

DRAW DIES

22.	Thin	Easy	70 to 110	60 to 100
23.	Thin	Medium	60 to 90	50 to 80
24.	Thin	Difficult	30 to 40	20 to 30
25.	Medium	Easy	70 to 90	60 to 80
26.	Medium	Medium	40 to 60	30 to 50
27.	Medium	Difficult	10 to 30	10 to 20

Dies which are very fragile in design and are punching very hard or difficult material, and are not capable of the above runs, should be assigned special logics

Protection of Accomplished Gains: Design standards on the different types of tools and the material used in the building of these tools are continually studied and revised. On general steel dies, economical runs have been established and are proving beneficial in securing a maximum number of pieces through the life of the die as shown in *Fig.* 10.

Systematic periodic inspection of equipment will help spot needed repairs before they can develop into a major over-all repair job. It is evident that improvement in product, cost and quality will be derived from the following:

1. Psychological effect
2. Corrective action of tool and equipment failures
3. Establishing standards of performance.

Once these gains have been established, proper and continuous organized control is necessary in order to maintain them.

Press Maintenance: Since a die operation may be adversely affected by press conditions, it has been decided to study the conditions and related causes of press failures. These are tabulated in *Fig.* 11 under ten major divisions.

Some of the causes are failure or improper functioning of clutch, brake, knocker and lubricating system which in turn can adversely affect ram and bed alignment, pitman or other connections, safety devices, and miscellaneous bearings, fittings and fastenings. Where stock feeding is used, poor feeding or dereeling can cause difficulties.

In order to aid in maintaining maximum ef-

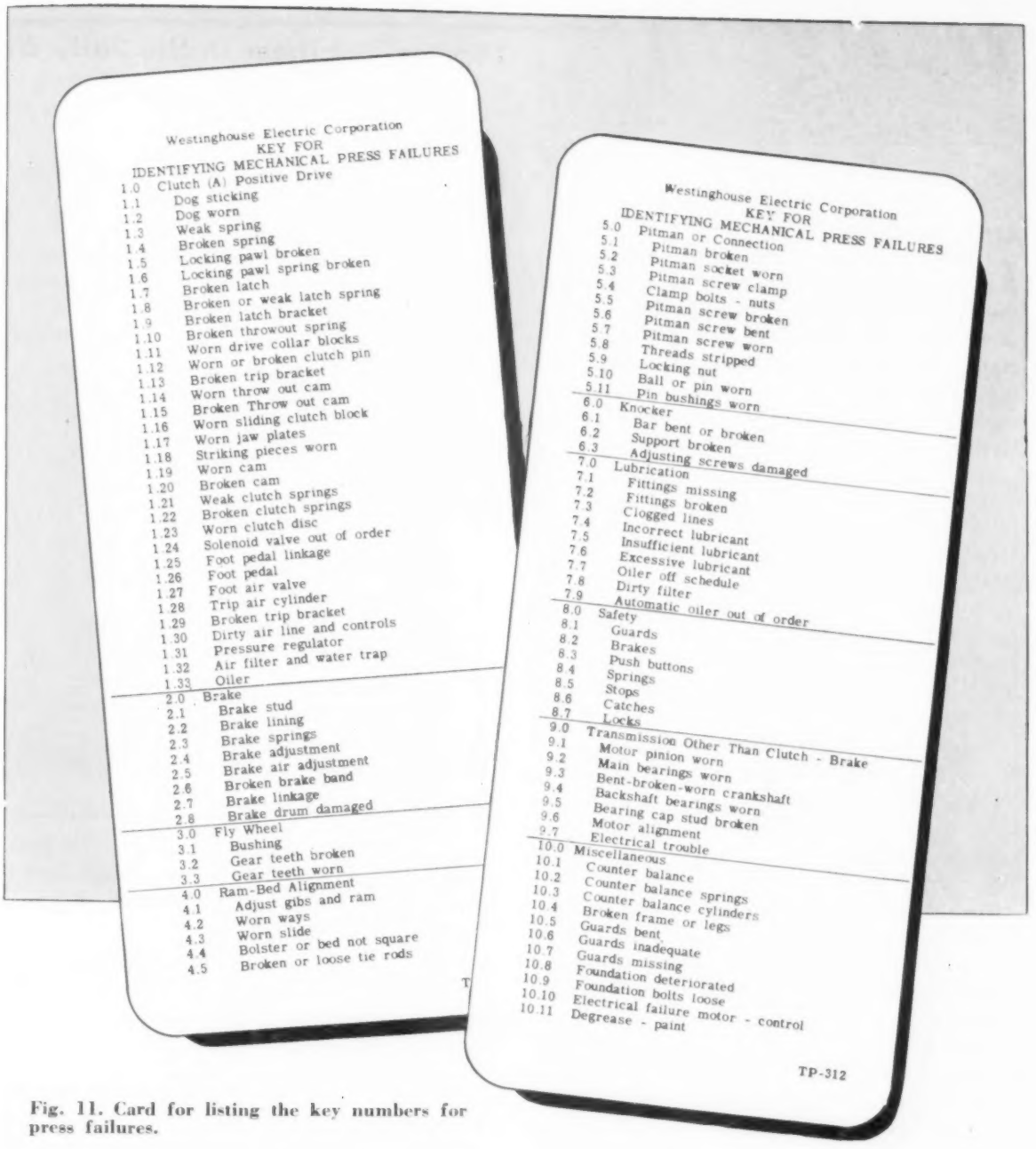


Fig. 11. Card for listing the key numbers for press failures.

ficiency it is necessary to recognize the effects of longer die runs between grinds, increasing of press speeds and tendency to closer tolerances on stamped products. For the occasional overload, due to more than one piece in the die, the result can be disastrous. In this connection the market is offering overload release devices of various types to protect the equipment from damage.

In view of the importance of break clearance, tolerances between punch and die observation of press operations is a must and it is necessary to maintain adequate press alignment. The causes of misalignment, as previously stated, are in part due to improper lubricating, overloading and feeding. There are several others not commonly recognized. One of these is failure to clean the press platen or die when clamping the die in place. Another is the setting of the die off center, causing an unbalanced loading of the press.

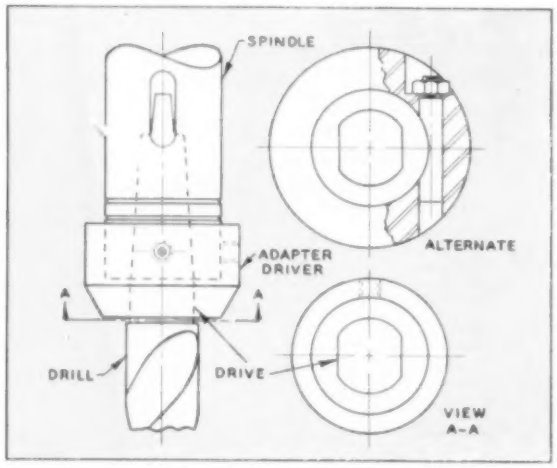
Safety: Application of safety guards and measures is a subject deserving individual consideration. Since dies are so varied in size, shape, and operating characteristics that the attendant problems may make for a tendency to slight the issue, it becomes necessary to continually keep it foremost in the stages of die design and construction, operation and maintenance. Guards can be of a general nature covering a group of dies. In other cases it may be necessary to apply a guard to individual dies. In addition, safety patrol can be of great help.

• Gadgets

Ingenious Devices And Ideas To Help The Tool Engineer In His Daily Work

Drill Driver

Under severe service, a taper shank drill may turn in the spindle, twisting off the tang. This necessitates use of an adapter by which the original taper shank is shortened with chance of recurrent loosening. By making an adapter driver as shown, and attaching it to the drill press spindle, drilling torque is taken by the body diameter of the drill, the shank and tang serving merely to retain the drill in the spindle.



The simpler adapter, shown at left, is bored out a drive fit on the machine spindle and to a depth to provide adequate bearing. Two or three set screws, tightened against the spindle, are usually enough to resist any reasonable torque. Opposed flats are ground on the body diameter of the drill, just below the taper shank, and the smaller hole in the adapter is machined a close matching fit.

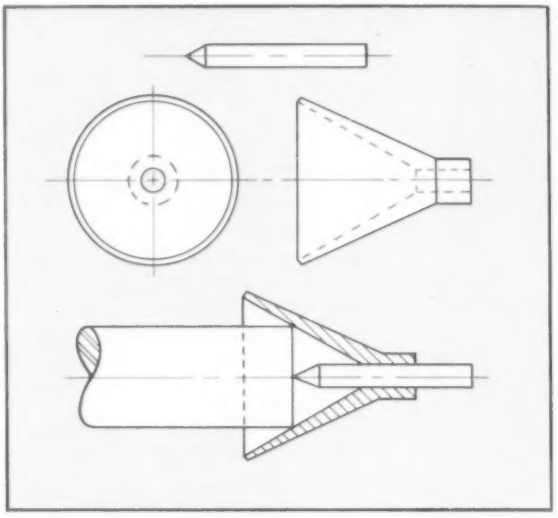
Should the set screws be objectionable on account of marring the spindle, make the adapter as suggested by the alternate. A lock pin is bored with the hole, then driven out and dressed to a slip fit. When the nut is drawn tight, the pin will jam against the spindle, locking the adapter solidly in place. Whichever type is used, the drill will break, or the machine will stall before the drill will turn in its socket or the tang twist off.

A. E. Walters
Santa Clara, Calif.

Contributions for these pages describing short cuts for the tool engineer are welcome. Finished drawings are not necessary. Payment for accepted articles is made upon publication.

Locating Centers

The device illustrated is easily made and quickly locates centers of round stock where a great degree of accuracy is not essential. The bell-shaped piece can be made in accordance with the range of sizes



most commonly required to center. The punch should be made of tool steel and heat-treated to center punch hardness. Ends of stock, of course, must be square.

W. H. Saling
Corpus Christi, Texas

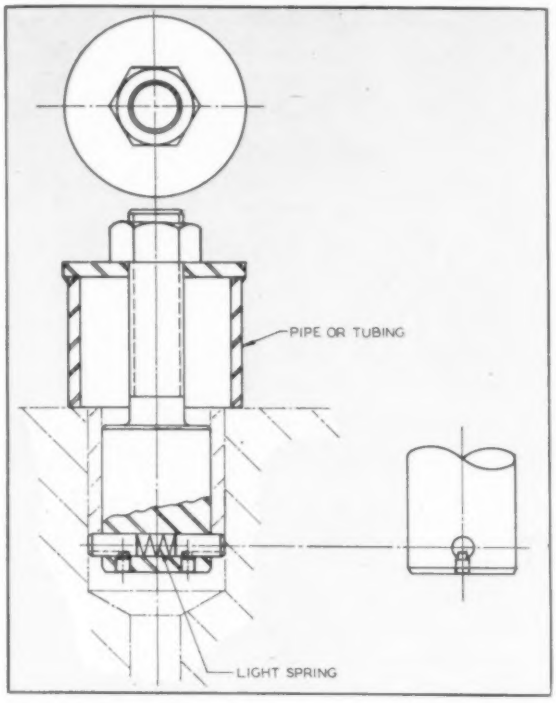
Bushing Puller

Several hundred large castings were on hand which had bushings in them which were reamed 0.005 inch oversize. Instead of scrapping the expensive pieces, an attempt was made to save the parts by removing the bushings and pressing in new ones. The part was so designed that access from the opposite end was impossible. A method had to be devised to press the bushings out from the front end, but at the same time, it was essential that the hole in the casting not be scored or marred.

The puller illustrated worked surprisingly well. A piece of cold-rolled steel was turned down to a slip fit in the ID of the bushing. Near the bottom a cross hole was drilled and reamed to receive two small pins. These pins had small slots end-milled in them to receive the heads of dog point set screws which prevented the pins from falling out. A round piece of standard pipe and a

flat washer were welded together.

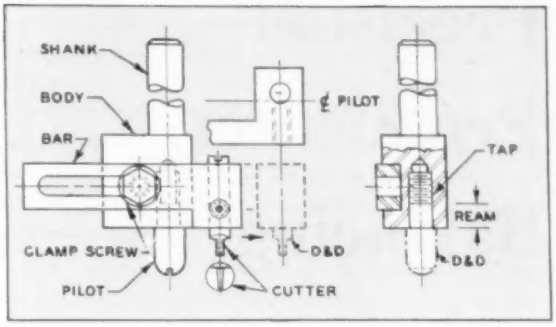
In use, the two pins are pressed together until the plug enters the hole in the bushing. When the pins reach the bottom of the bushing, the two pins spring out underneath the bushing. By tightening



the nut shown at the top, the bushing will come out straight and evenly.

Roger Isetts,
Kenosha, Wis.

Circular Hole Cutter



Circular hole cutters that embody a bent cutting tool have the disadvantage that the tool will spring, causing chatter, when extended. Also, the cutter must be made quite wide to allow for clearance between small and large diameters.

The tool shown overcomes these disadvantages to a considerable extent. A bar, sliding in the body, carries a straight-shank tool which can be rotated to the desired circle with a screw driver. The cutter can therefore be made as thin as desired. After adjusting for diameter, the bar is locked with a clamp screw, and cutting thrust is taken up by the body.

The body has a pilot hole central with the shank, and this hole is reamed partway, then tapped. Interchangeable pilots are threaded with a short portion turned or ground to fit the reamed section of the hole. Pilots are slotted and may be inserted and removed by means of a screw driver.

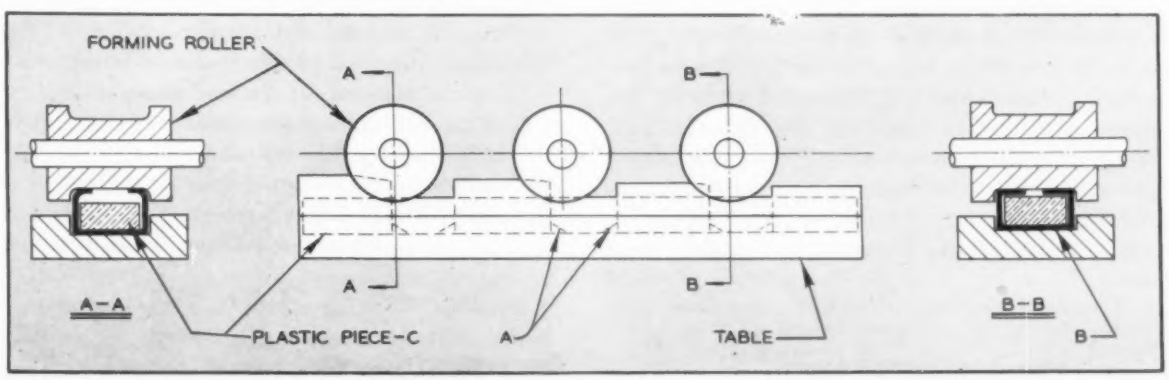
Andrew E. Rylander
Walnut Creek, Calif.

Assembly Device

The mechanism described here is used to assemble the plastic piece C by bending over the two sides of the U-shaped strip B. Before this mechanism was designed, the two parts were assembled manually by hammering the two edges over the plastic piece. In some cases the plastic piece broke and in others it was too loose after completion.

The assembly mechanism consists of three gear-driven bending rollers and a table with a U-shaped groove in which the U-shaped metal strip is placed. The plastic pieces are then set into the U-shaped metal strips between the shoulders A which prevent the pieces from moving forward. The metal strip is moved forward from left to right until it contacts the first roller which begins to bend the metal strip A as shown in section A-A. The roller moves the strip forward to the second and third rollers, completing the assembly as shown in section B-B.

Peter Balsells
Dayton, Ohio



Precision Production Balancing*

By George C. Lawrie

Chief Engineer
Tinius Olsen Testing Machine Co.
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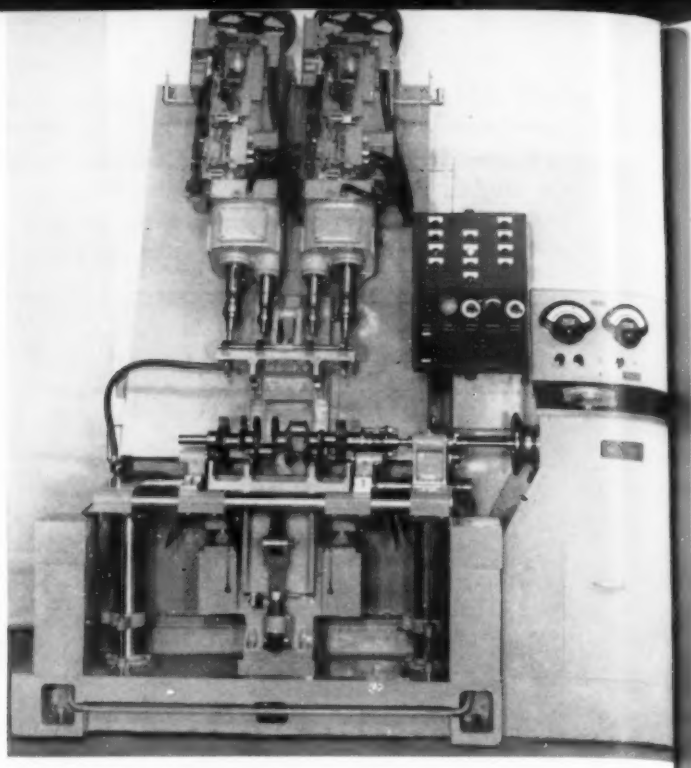


Fig. 1. Special purpose machine for precision high-production balancing of automotive crankshafts. Covers are removed to show mechanisms.

BALANCING OPERATIONS, when properly performed, remove undesirable vibration induced by rotating parts. The need for balancing increases with increase in operating speed. In fact, it increases as the square of the speed. The high speeds in common use today would be utterly impossible without adequate balancing. Shown in *Fig.* 1 is an automatic machine for balancing automotive crankshafts.

To indicate the effect of unbalance at various speeds, a curve of centrifugal force exerted by an unbalance of only one ounce-inch is shown in *Fig.* 2. It is interesting that this comparatively small unbalance of one ounce-inch exerts a force of only slightly over one ounce at a speed of 200 rpm. At 5000 rpm, this same unbalance will exert a force of nearly 45 pounds. If the operating speed is increased to 10,000 rpm, then the shaking force is four times greater or nearly 180 pounds.

The causes of unbalance are many, depending upon the type of machine under consideration, but basically it is due to lack of symmetry of mass distribution about the axis of rotation of the body. In other words, the mass axis and the geometric axis do not coincide. Sometimes this results from errors in design where inadequate provision has been made for inherent unbalanced forces.

If the rotating body is a casting or forging, there is likely to be considerable unbalance present in the finished part, since the unmachined surfaces cannot be held concentric with the axis within close dimensions. Also in the case of castings in particular, the material may lack uniform density.

Fits of mating parts must be held closely, otherwise individual parts may be assembled in an eccentric position with relation to the bearing surfaces. This holds true even though the individual parts may be in perfect balance about their own axis.

Differing from dynamic balancing, static balancing is a term usually applied to single plane correction for balance, and should be confined to parts which are relatively short in relation to their diameter. Static unbalance can be determined by the use of level ways or rollers, or by rotating the part in a static balancing machine which utilizes the centrifugal forces of the unbalance to permit measurement of the amount and angular location of the unbalance. However, neither method determines the longitudinal location of the unbalance along the axis of the part. This is the reason why this method should be used only for very short parts. Otherwise the correction, if made out of the plane of the actual unbalance, would thereby set up a force couple, resulting in a dynamic unbalance which was not present originally.

Dynamic balancing usually means two plane correction and can be accomplished only by rotating the body in a dynamic balancing machine. Thus

*Abstracted from Paper 21T19, "Precision Production Balancing" presented before the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society headquarters.

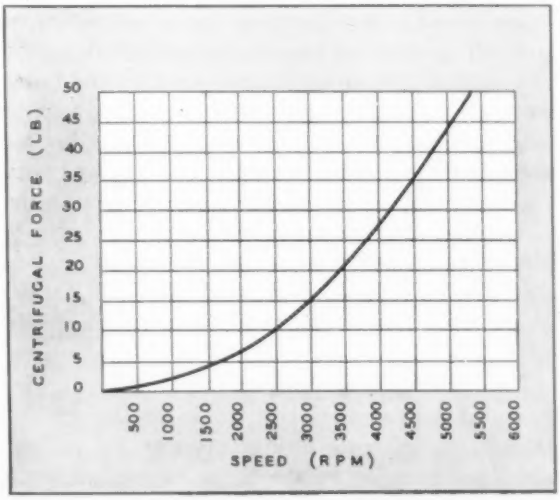
the centrifugal forces due to the unbalanced mass distribution can be measured and located angularly in any two transverse planes which may be selected for correction. These two forces are the resultants of all elementary unbalances in the body and correction can be made only at two or more points to form a corrective couple. Where a dynamic unbalance exists, correction cannot be made by adding or removing weight in one plane only.

It should be remembered that the amount and angle of unbalance as measured in any two transverse planes through the body will change with any shift in these planes. In other words, if unbalance amounts and angles are measured at the bearings of the work, where most balancing machines pick up vibration, these values will change if referred to any other planes, such as the two correction planes, and the machine must be capable of transferring these values with the proper corrections, both as to amount and angle, to the planes selected for making the actual balance corrections.

In production balancing it is essential that provision be made in the design of the part for balance corrections. In other words, if the part requires dynamic balancing, there should be two transverse planes, preferably separated as far as possible, in which weight can be added or removed. This is often overlooked in the design stage with resultant higher cost and inconvenience.

Probably the quickest and most accurate method of making balance corrections, and especially in production balancing, is by drilling to remove weight. By this method the weight removed can be accurately controlled by regulating the depth or number of drilled holes. This can be done manually or automatically, the depth being controlled by the signal from the balancing machine. Metal can also be removed by grinding but since this method relies entirely upon the judgment of the operator as to how much weight is removed, it is not much used in production balancing.

Fig. 2. Curve showing centrifugal force exerted by one oz-inch unbalance at various speeds.



If the construction is such that it is not practical to remove weight, then balance correction must be effected by adding weight in some manner. Here again, provision should be made in the design of the part for quick and accurate weight addition. Probably the most convenient means is the use of slugs graded in weight to be spot welded to the part or otherwise attached.

For instance, in some types of motor armatures, preformed slugs of different lengths, are driven into the armature slots at each end of the laminations, corresponding to the two planes of correction. Other parts such as separator bowls may be corrected by flowing on a calibrated length of wire solder. Each part should be carefully studied to determine the most efficient method of balance correction, and the necessary provisions made for such correction.

Having carefully considered the design of the part to determine and provide for the best method of correction, it then becomes necessary to select a balancing machine to perform this operation. If the production of any particular size or shape of part is not too great, but rather tends toward a variety of different parts, then a general-purpose machine is indicated.

This type of machine will indicate the amount and angle of unbalance accurately in the selected planes but leaves the burden of making the necessary corrections to the operator. It must be constructed so that a quick change-over can be made to accommodate a variety of parts, and must be such that a quick and easy calibration of the machine indication in terms of unbalance units such as ounce-inches can be made. Suitable charts can be made up and a record of the machine settings can be taken for that particular part, so that the machine setup may be quickly duplicated at any time.

Where a single part is to be balanced, the best procedure is the use of temporary corrections such as modelling clay or by clamping on temporary weights in the planes of correction, and then after the part has been brought to balance, making permanent corrections by drilling or grinding diametrically opposite the temporary corrections, or by securing permanent weights equal in balance effect to the temporary weights.

Production balancing, however, requires the use of highly special equipment, often designed to handle one particular part, and not readily adaptable to other parts. Balancing machines are designed for ease and efficiency of operation, and often include means for automatically making the necessary balance corrections. The special nature of such equipment naturally makes the cost somewhat high, but is warranted by the high production which would otherwise be impossible.

Shown in *Fig.* 1 is an Olsen automatic crankshaft balancer, a special purpose machine designed especially for precision balancing and high production, with means for automatically removing the correct amount of weights by drilling at the correct angular locations in each end of the shaft, to bring the shaft within the required close limits of balance.

With the aid of a hoist or other handling equipment, the operator lays the crankshaft on the four hardened and ground support rollers, with the flange toward the right end or headstock of the machine. These rollers bear on the two end main journals of the shaft and are individually adjustable in order to properly align the shaft with the driver. The shaft is carried by a vibratory cradle supported on four vertical rods, two at each end, extending down to the base of the machine.

In addition to the support roller brackets, there are also two pivot brackets on this cradle, located in the two planes of correction, in this case in the planes of the two main counterweights near each end of the shaft. This construction permits the unbalance forces in the crankshaft, when rotated, to cause the cradle to oscillate in a horizontal plane about either of the two pivot points, which may be individually engaged and disengaged by the action of air cylinders remotely controlled. The shaft is driven through a driver which engages driving pins in two of the holes in the flange of the shaft. This driver which is mounted on the vibratory cradle of the machine, must be driven through specially constructed universal joints to allow free vibration of the cradle without any external disturbances.

Also attached to the cradle by means of actuator rods, are two pickups, one at each end of the cradle. These are velocity pickups and generate an alternating current proportional to the amplitude of vibration of the cradle and hence proportional to the unbalance being measured. The phase relation of this alternating current to the rotation of the part being balanced, is a measure of the angular location of the unbalance.

After placing the crank on the rollers and engaging the driver, the operator simply presses the "measure" button. This starts a timing motor which controls the cycling of the various operations performed during the measurement of unbalance in the two correction planes.

First the driving motor starts and brings the shaft up to the machine operating speed, during which time pivots in both planes are locked, holding the cradle rigidly. After the shaft is up to speed, the right correction plane pivot is automatically opened by means of an air cylinder controlled by a solenoid valve. This permits the cradle carrying the rotating shaft to vibrate in a horizontal plane about the locked pivot in the left correction plane as a center. This vibration is caused by one of the two resultants of all elementary unbalances in the part, the other resultant being temporarily eliminated by the locked pivot.

The operation of opening either cradle pivot cuts in the corresponding cradle pickup. The alternating current signal from the pickup is fed into an electronic measuring head which automatically indicates on the panel meters both the amount and angular location of the unbalance in the right correction plane. At the same time the electronic control also transmits signals to servo systems which serve as memory devices for these values and set cams controlling the depth of drilling and indicating pointers on the angle servo. After these settings

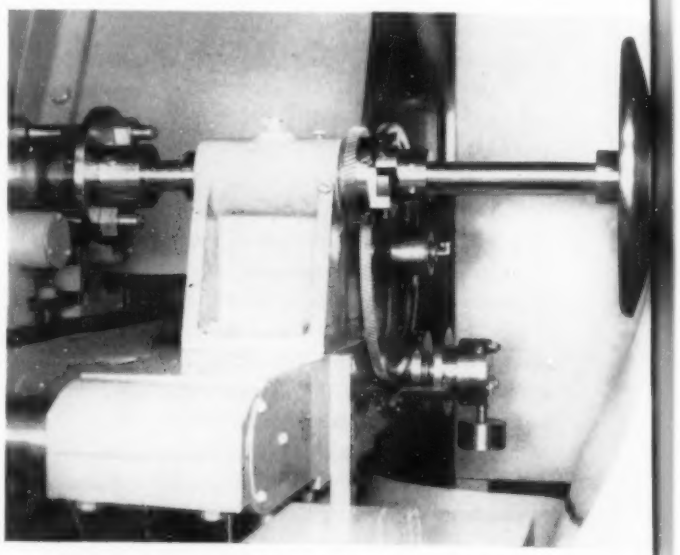


Fig. 3. Gearing and bobweight unit eliminate necessity of clamping weights to crankpins.

have been made for the right correction plane, the right pivot locks and the left opens, and the unbalance in the left plane is measured and the servo system for amount and angle of unbalance in the left plane is set.

When measurements for both correction planes have been taken, the shaft is automatically braked to a stop and at the same time a pneumatically operated lift operates to engage the crankshaft on the underside of intermediate main journals, and raises the shaft from the support rollers on the cradle, to clear them slightly. The driving pins are flexible and permit this slight lift while still engaged with the shaft. The purpose of this lift is to take the thrust from the drilling operation since obviously neither the vibratory cradle nor the support rollers are sufficiently rigid to withstand the drill thrust. At the same time both cradle pivots automatically lock.

The operator then turns the crank manually by means of a handwheel until an index line on the angle servo reference disk aligns with the pointer which has been set by the servo corresponding to

the signal from the electronic measuring head for the right correction plane. This operation places the heavy spot directly under the right drill.

The indicating points and reference disk on the angle servo are visible through a glass cover flush mounted in the sloping panel just below the indicating instruments. Also located just below the glass cover is a stationary disk, which is angularly divided corresponding to the angles subtended by the extreme drilling positions in the counterweights. The various angular areas are colored for easy identification of permissible drilling areas, and the tips of the two indicating pointers project beyond the edge of this colored disk, so that the operator can see at a glance whether the unbalance in either end of the shaft falls within the permissible drilling area of the counterweight. The tips of the two indicating pointers are also colored for identification of the two correction planes.

If the indicating pointers show that the unbalance in either or both ends of the shaft does not fall within the permissible drilling area of the main counterweights, as sometimes happens, then the operator can use the second spindle on either of the drill heads for auxiliary drilling in adjacent counterweights. This is not for the purpose of bringing the shaft into balance, but to throw the remaining unbalance within the angular range of the main counterweight, so that final correction con be accomplished by use of the automatic cycle.

The depth of drilling with the auxiliary drills is manually controlled by two depth control knobs on the panel which set the depth servo cams, corresponding to a depth scale for each knob.

After the operator has positioned the shaft and noted that the unbalance falls within the allowable correction area, he presses the "right drill" button on the panel. The air-operated clamp moves down to clamp the shaft firmly in the lift and at the same time the right drill starts and the drill head moves down in rapid traverse and trips into feed when less than one-eighth inch from the counterweight surface. The clamp also serves as a bushing plate for the drill guide bushings.

The drill continues downward at feed rate until the point of the drill contacts the work. The drill head is so constructed that pressure on the point of the drill lifts the spindle a few thousandths. This trips a precision limit switch within the drill head that releases a depth measuring contact allowing it to move in unison with the head. This permits automatic control of the depth of drilling regardless of variations in the starting point.

The depth servo is built around a cam, the contour of which is carefully calculated to convert unbalance in ounce-inches into a depth of hole. These calculations take into account the specific gravity of the material being drilled, the starting radius of the drilled hole, the drill point angle, and of course the diameter of the drill.

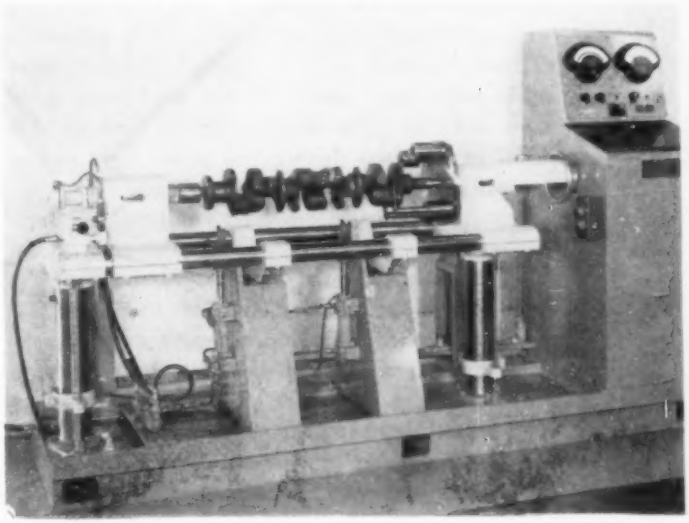
This cam is positioned by a servo mechanism actuated by the signal obtained during the measuring cycle. When the depth measuring contact, moving down with the drill head, contacts the cam, the quick return solenoid valve is actuated and the drill head retracts. At the same time the clamp and lift are withdrawn to their original positions.

When V-8 crankshafts are to be balanced a problem arises which is taken care of in an interesting way in this machine. In a V-8 shaft the primary couples are unbalanced, which means that during the balancing operation a weight must be added to each crankpin corresponding to portions of the connecting rod and associated parts that are missing. The usual procedure is to clamp bobweights, as they are known, to each individual crankpin. This is a time-consuming operation and has been entirely eliminated in this balancer by the use of what are termed "bobweight eliminators." It is nothing more than an artificially created force couple, rotating in synchronism with the shaft, and so positioned in phase with the shaft and of the proper value to exert a force on the cradle of the machine equivalent to that which would be applied if the bobweights were actually in place on the crankpins.

The gear drive for the bobweight eliminator shaft and also one of the bobweight eliminator weights is shown in *Fig.* 3. The force couple is produced by two unbalanced weights spaced 180 degrees from each other and located one at each end of a shaft which is geared to the driver with a one-to-one ratio.

This automatic crankshaft balancing machine was developed to make the final balance corrections in the shaft, but actually when production balancing is being considered, and especially in connection with crankshafts, the balancing operation has entered the picture long before the crank arrives at

Fig. 4. Mass center checking machine for locating centers near the mass axis.



final balancing. In fact even before the shaft is machined a form of balancing known as "mass centering" is often used.

This consists essentially in locating the centers to be used for subsequent machining operations on or near the mass axis of the shaft in order to keep the final balance correction to a minimum, or in some cases, to actually throw the unbalance into some desirable angular location on the shaft, such as in the counterweight, where it is feasible to make corrections by drilling.

Crankshafts made by the new shell mold process are held to such close dimensions in the rough, that

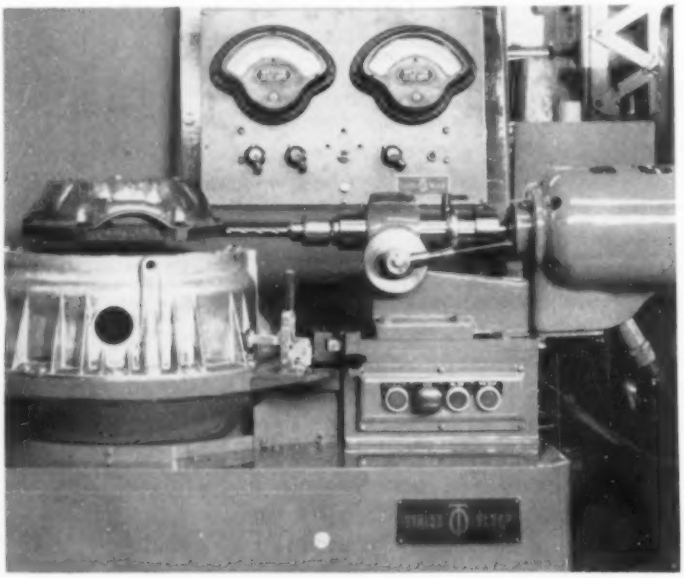


Fig. 5. Vertical static balancing machine arranged to balance torque converter housings and clutch assemblies.

this process shows promise of eliminating the necessity for the mass centering operations.

In order to check the quality of the mass centering operation, the machine shown in *Fig.* 4 was developed. This machine mounts the rough shaft on centers, and the whole is mounted on the vibratory cradle which is provided with pivots adjustable to the two normal correction planes. The vibratory cradle principle is similar to that used in the automatic machine. The shaft is driven through universal joints and a driving rod at the right end of the cradle underneath the protective cover.

The peculiar driver construction at the right end of the shaft is necessitated by the fact that all indexing is referred to the No. 1 crankpin, hence the drive dogs of the machine are made to engage this pin. The extended drive dogs present a little problem in dynamic balance of the driver itself, and this is accomplished by proper positioning of counterweights on the driver plate as shown.

The tailstock center carrying the flange end of the shaft is pneumatically operated, and is interlocked through a sequence valve, with the shaft supports shown on the sides of the pivot stands. These are shown retracted, but when the control valve at the left end of the cradle is operated, the shaft supports will first move up and contact the shaft to support it, before the tailstock center withdraws. The shaft can then be lifted out of the machine. Upon placing a shaft in the machine the reverse action takes place.

The same electronic measuring head is used as in the case of the automatic machine, so that the operator can quickly read the amount and angular location of unbalance in each of the two reference planes by simply interchanging pivots.

No means of correction is provided on this machine since its purpose is to spot check the mass centering operation and to provide the data necessary to adjust the mass centering machine to keep the unbalance within allowable tolerances of amount and angular location which may be set up for this operation.

Shown in *Fig.* 5 is variation of an Olsen vertical static balancing machine, especially arranged for handling torque converter housing and clutch assemblies. This is an awkward part to handle since the housing must be held stationary while the clutch is rotated to obtain unbalance indications.

In this machine the cradle is vertically mounted and can best be compared to a swinging door with hinges along one of the vertical edges, and the spindle mounted along the free edge. The housing is located by dowel pins and clamped to the flat surface provided on the cradle, and the spline shaft on which the clutch is mounted runs in ball bearings in the housing, and projects down through the housing and engages a spline in the balancing machine spindle.

As the clutch is rotated, static unbalance in the part sets up vibration of the cradle about the hinged side, and hence a magnetic pickup attached to the free side of the cradle generates an alternating voltage.

This is fed into the same type of electronic measuring head as is used on the automatic balancing machine. This machine also is equipped with an electronic memory device which holds the meter pointers at their respective readings until corrections are made and the machine is again started for a check run.

Correction is made by drilling manually in the edge of the clutch plate. The drill mount is pivoted so that it can be swung aside to clear the converter housing for loading and unloading.

Problems encountered in production balancing are as varied as are the rotating parts themselves. Each part must be carefully considered in the light of service requirements, mounting conditions, balance corrections, etc., in order to get the highest production consistent with the required precision.

Automation of Machine Tools*

Part 1—Principles of Control

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CONTROL IS A MEANS for directing the magnitude and sense of energy flow into a drive mechanism or motor to produce a desired effect. Information on the desired effect is usually of a low energy order, such as setting a dial or pushing a button. The motor, which does the work, usually requires relatively large amounts of energy. Obviously, a link is needed to connect the low energy order with the high energy motor. This link is provided by the control system, but the responsibility of the control system does not end here. Just as important is the performance of the device which translates and transmits the order, the motor which does the work, the behavior of the load, and the nature of external disturbing forces on the load.

A control system may be manual, semiautomatic or fully automatic. Regardless of the elements involved, control systems as a whole or in part may be considered in one of two basic categories:

1. Open-end or open-loop control.
2. Closed-loop or feedback control.

Accuracy in the open-loop system relies on the precision with which a calibrated mechanism will operate on an output in response to a command. This system is open-end or open-loop because there is no check back to establish how well the command is carried out. If the loop were closed, error could be measured and corrective action taken. This is what the closed-loop or feedback system does. The measured error between command and response is used to actuate a drive mechanism which in turn adjusts the output until

*Abstracted from paper 21T18, "Automation of Machine Tools," presented at the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society Headquarters.

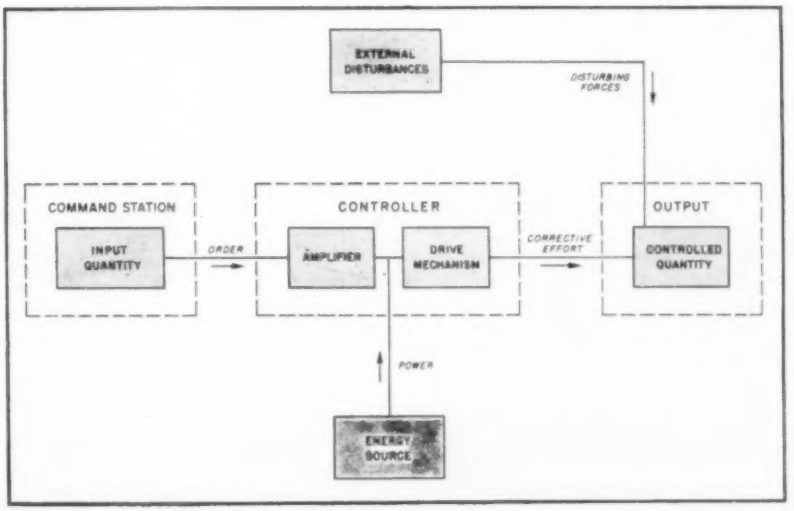


Fig. 1. Block Diagram of open-loop control system.

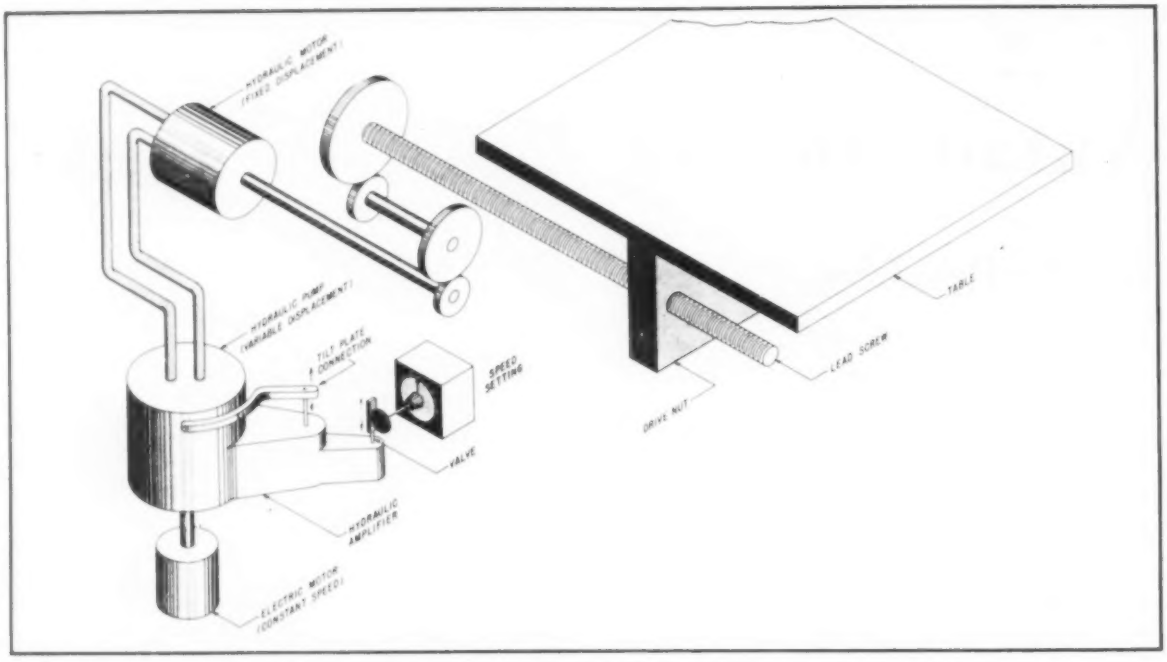


Fig. 2. Open-loop speed control of milling machine table cross slide.

the error disappears or cannot be measured. A feedback system is accurate simply because it cannot tolerate error: the system will labor until error essentially vanishes.

As an example, consider the operation of a contour cutting machine from a pantograph linkage. The pantograph pointer may be traced over the contour of a drawing or template manually. This is closed-loop control for an error, observed by the eye causes the hand to correct the discrepancy. However, control from the pointer, through the linkage and machine tool to the workpiece is open-loop. Errors in the pantograph linkage, gearing, tool accuracy, vibrations, heat expansion etc., all go uncorrected.

Open-Loop Control

An open-loop control system is shown in the block diagram in *Fig.* 1. The objective of this system is to accurately control the output in proportion with an order originating from the command station. The output may be a machine or process, while the variable actually to be controlled is designated the controlled quantity.

Within the controller there are two basic elements, the amplifier and the drive mechanism. The amplifier raises both the volume and power level of the order signal, draining power as required from the energy source. This strengthened order signal then powers the drive mechanism, which works to alter the controlled quantity. In many systems, external factors disturb the controller and controlled quantity setting, resulting in deviation from the desired response.

Accuracy of the open-loop control system depends on the calibration of all tandem system elements. In the face of external disturbances and variations of quantities such as line voltage, ambient temperature, pressure and humidity, aging of components, and changes in loading, the problem of precise setting and maintenance of calibration becomes a formidable, expensive and all too often, impossible job. All these factors point to the main fault in open-loop control. Errors can neither be recognized nor corrected.

Speed control of the table cross slide on a milling machine might be done in open-loop fashion. Discontinuous control could be accomplished by gear changes from a fixed-speed drive. For purposes of discussion, consider the variable speed hydraulic drive, shown in *Fig.* 2. Speed of the fixed-displacement hydraulic motor is nominally determined by the volumetric flow rate of oil from the variable displacement pump, driven by a constant-speed electric motor. The oil flow rate is proportional to the axial motion of the pump tilt plate about the neutral zero pumping axis. The tilt plate is driven by a piston-type hydraulic amplifier, actuated by a valve calibrated in table speed. The hydraulic amplifier produces a displacement of the tilt plate proportional to valve motion.

Accuracy in this system is determined by the calibration of table speed versus valve movement. Calibration tends to be destroyed by such things as variations in the pump motor speed, resulting from power supply fluctuations and load regulation; oil leakage flow, which is a function of load torque; inaccuracies in the hydraulic amplifier;

hydraulic dead band in the valve; wear of parts; temperature variation.

To expect such a system to sustain an accuracy better than five percent is not realistic. Compensation is possible, but at best becomes difficult and expensive while providing only marginal improvements. To achieve the greater accuracy required for most profitable use of modern tools and materials, closed-loop control should be used.

Closed-Loop Control

A simple method for overcoming the shortcomings of the open-loop control system shown in *Fig.* 2, would be to connect a tachometer to the hydraulic motor, with the machine operator standing by at the valve to correct any observed errors in speed. Under these conditions, the control is no longer open-loop. The operator, with the aid of the tachometer, closes the loop manually.

Converting this system to full automatic control is straightforward as shown in *Fig.* 3. Simply stated, the device used to measure the speed is now used to control it. The output voltage from the tachometer is bucked against the speed signal from a speed signal potentiometer in the input circuit of an amplifier. The difference voltage or error signal is strongly amplified, both in magnitude and power to drive a torque motor which connects directly to the speed setting valve. Only a minute error signal voltage is required to fully displace the valve; i.e., provide maximum output speed.

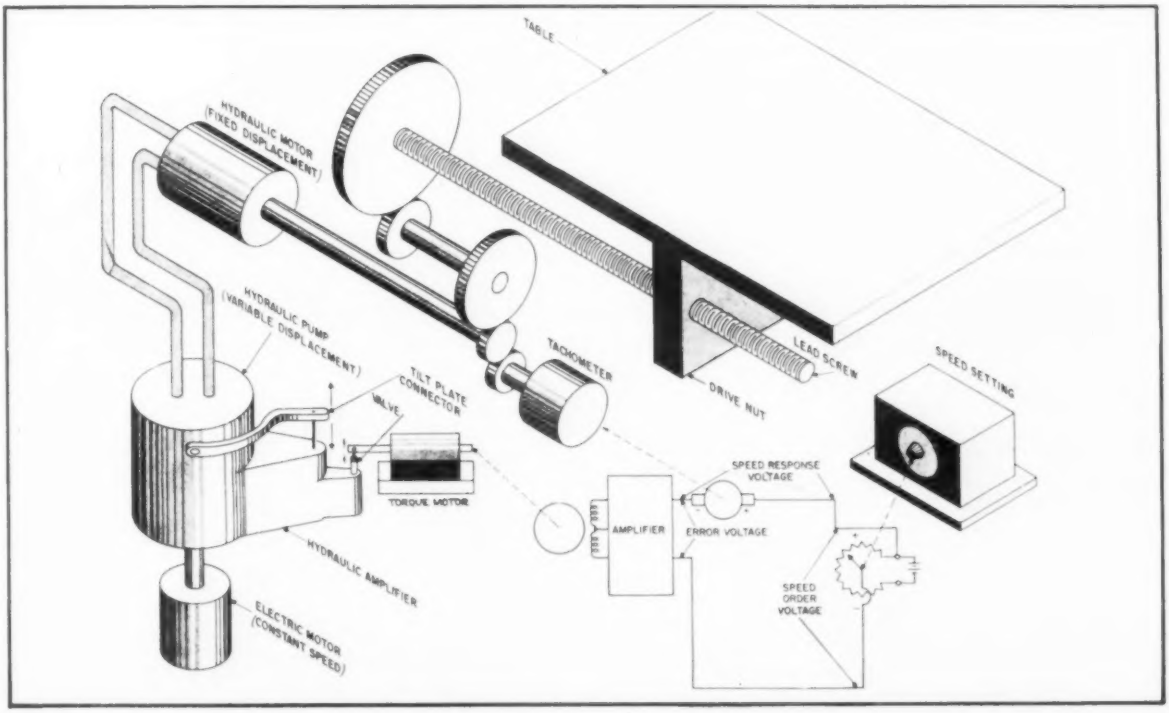
It is easy to see that the system will correct itself for any disturbance in speed from the designated value. For example, should the speed be less than ordered, the tachometer voltage will decrease, providing a net increase in the voltage applied to the amplifier. The amplifier responds instantly to increase the voltage at the torque motor, increasing the valve displacement and thereby speeding up the hydraulic motor. When the correct speed is reached, the net signal at the amplifier input is reduced to the null value required to sustain the desired speed.

Accuracy in this system is limited by two factors. First is the precision of the speed signal potentiometer and speed response tachometer. Potentiometers are available to 0.1 percent accuracy or better for fixed settings; tachometers are readily available to 0.2 percent. Thus, with relatively inexpensive commercial equipment, instrument errors in the order of 0.3 percent maximum might be expected.

The second source of error, peculiar to closed-loop control, arises from the difference signal required at the amplifier input to drive the load. This difference signal is a measure of the speed error, since a signal will exist only if speed signal and speed response are not exactly matched. In this system, a difference signal arises because the valve must be moved to a position providing the required pump displacement. Additional valve motion is required to supply leakage flow resulting from load torques.

Static loading on the valve plus hydraulic dead band cause additional errors. The hydraulic ampli-

Fig. 3. Closed-loop speed control of milling machine table cross slide.



fier also may have a certain amount of backlash. The errors, resulting from these effects, may be reduced appreciably by increasing the gain (ratio of output to input voltage) of the amplifier to the point where the net input voltage represents a negligible speed increment. This error easily may be held to 0.2 percent. If the 0.3 percent error due to calibration is added to 0.2 percent from closed-loop operation, the maximum possible error becomes 0.5 percent, some 10 times less than in the open-loop system.

To obtain this self-correcting type of control with improved accuracy, a tachometer, potentiometer, amplifier and torque motor were added. These are relatively small, low-power, inexpensive units. Precision is required only in the potentiometer and tachometer. Accurate calibration of heavy power equipment, required in the open-loop scheme, is eliminated. In the closed-loop setup, calibration is required only at the instrumentation level.

A generalized block diagram of the closed-loop system is shown in *Fig.* 4. In this diagram there is only one functional box which does not appear in open-loop control, the error measuring device. This device compares the order with the response and transmits the difference, or error, as an input to the controller. The controller reacts instantly and applies a strong corrective action to the controlled quantity, forcing it in a direction to reduce the error. The controller draws its power from the energy source and will continue to labor until its input, measuring system error, is eliminated.

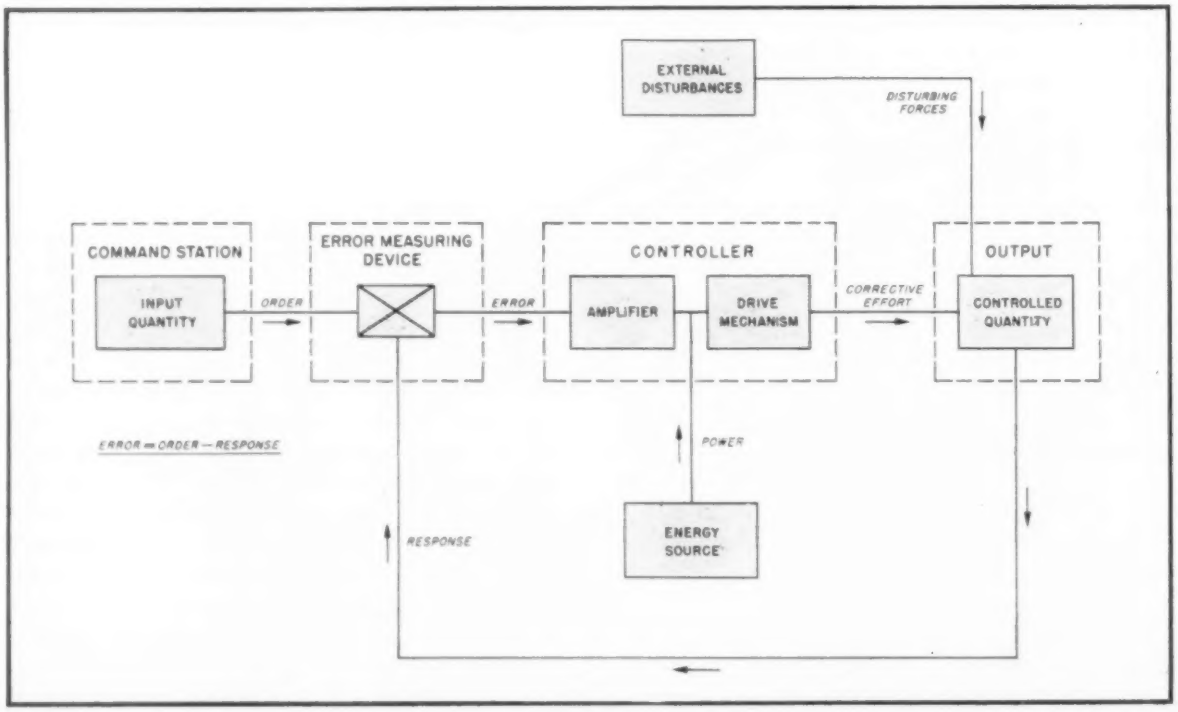
In this system the only basic source of error, other than inaccurate calibration of order and response, arises from the input signal required to drive the load and supply system losses. The controller will only deliver power in response to input and the only source of input is system error. This error, as indicated previously, may be decreased by increasing the controller gain or amplification. The larger the gain the less error is required to supply the same corrective action at the controller output.

Unfortunately, the gain cannot be increased indefinitely without soon causing the sort of trouble called hunting, oscillation or system instability. When this occurs, the controlled quantity hunts about its zero position either continuously, or for a long time before coming to rest. However, by introducing some form of electrical, mechanical or hydraulic damping the system can be brought to rest in a minimum of time, dead beat if necessary.

Since the inception of feedback control, stability with high gain has been a problem. Today, this problem is handled readily in many ways. The problems of damping, accuracy and dynamic performance are mutually dependent. Careful thought must always be given to instrumentation to provide the best and least expensive solution with the greatest degree of reliability. High-gain stable systems are commonplace. In fact, even zero-error low-gain systems are possible by using some of the more advanced methods available.

Where the controlled quantity is to be main-

Fig. 4. Block diagram of closed-loop control system.



tained at a fixed value, the term regulator is applied to the control system. Where the orders may be both remote and subject to variation, the term servomechanism is applied. Servomechanism, taken literally, means slave mechanism, a device conceived to follow commands faithfully.

Although more popularly considered as positional follow-up devices, servomechanisms are extremely flexible. The flexibility is a result of the servomechanism having "brains" as well as "brawn." The brains are inherent in the equation-solving property, automatic nulling. Regardless of settings of input variables, the controlled quantity is always driven to a value which satisfies the relationship that the sum of all inputs to the null circuit be zero. Thus, if speed is to be controlled, as in the milling machine in *Fig.* 3, a tachometer is used to give the speed response. If position is to be controlled, a synchro might be used to give position response. If torque is to be controlled, a torque-type strain gage transducer may be employed. Once a machine is adapted for feedback control, basic changes in the type of control are easy to obtain by switching small, lightweight transducers. The heavy power drives are unchanged.

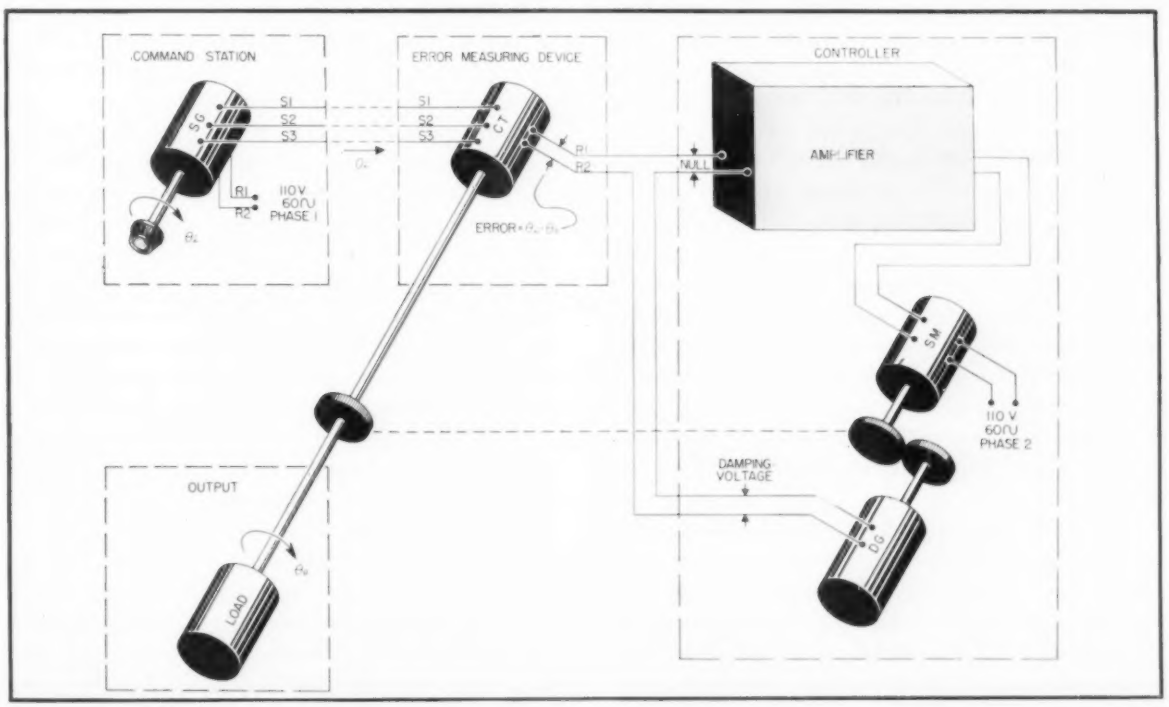
A servomechanism responds more readily to commands of low frequencies than high. Since most variables in machine or process controls vary at fairly low frequencies, this means that information gets through to the output much more readily than spurious high frequency jitter and noise. A servomechanism is thus not only capable of solving equations, it also has judgment in that it can discriminate between noise and information. This property is frequently valuable in machine and process control.

Capabilities of servos are numerous. One type of service is illustrated by the simple angle repeater servo shown in *Fig.* 5. The problem is to continuously and accurately position a rotary load according to an angular order from a remote station. This particular servomechanism might be used in analog computers where the power requirements are not in excess of a few watts. The same kind of system, however, can be used at all power levels; only the controller changes to accommodate the load. Shaft rotation may, of course, represent linear or angular motion, or any function, for that matter.

Angle transmission from the remote station to the servo utilizes a conventional 60-cycle synchro system. The shaft angle (Θ_i) of the synchro generator *SG* is repeated at the synchro control transformer shaft *CT* when the voltage output of its rotor leads R_1 and R_2 is a null. The *CT* is directly coupled to the load which has an angular heading designated Θ_0. For small angles, the *CT* output voltage is proportional to the difference or error between Θ_i and Θ_o. Also the polarity of the voltage corresponds to that of the angular error.

One way of providing accurate tracking Θ_i to Θ_o is to connect a voltmeter to the *CT* leads R_1 and R_2, and manually rotate the *CT* shaft so as to maintain a continuously indicated null. Manual tracking is, of course, unnecessary. Automatic tracking can be easily accomplished by connecting the *CT*

Fig. 5. Angle repeater servomechanism.



rotor leads to the input of the servo controller. Should an error exist, the signal from the *CT* is multiplied many times by the amplifier which applies a powerful voltage to the servo motor *SM*. The motor responds with a proportionate torque and drives the load and *CT* to correspond with the order.

High-gain servos, such as this example, would tend to hunt or oscillate continuously if some form of damping were not provided. The damping generator *DG* accomplishes electrically what a viscous damper connected to the motor shaft would do mechanically in limiting or preventing hunting.

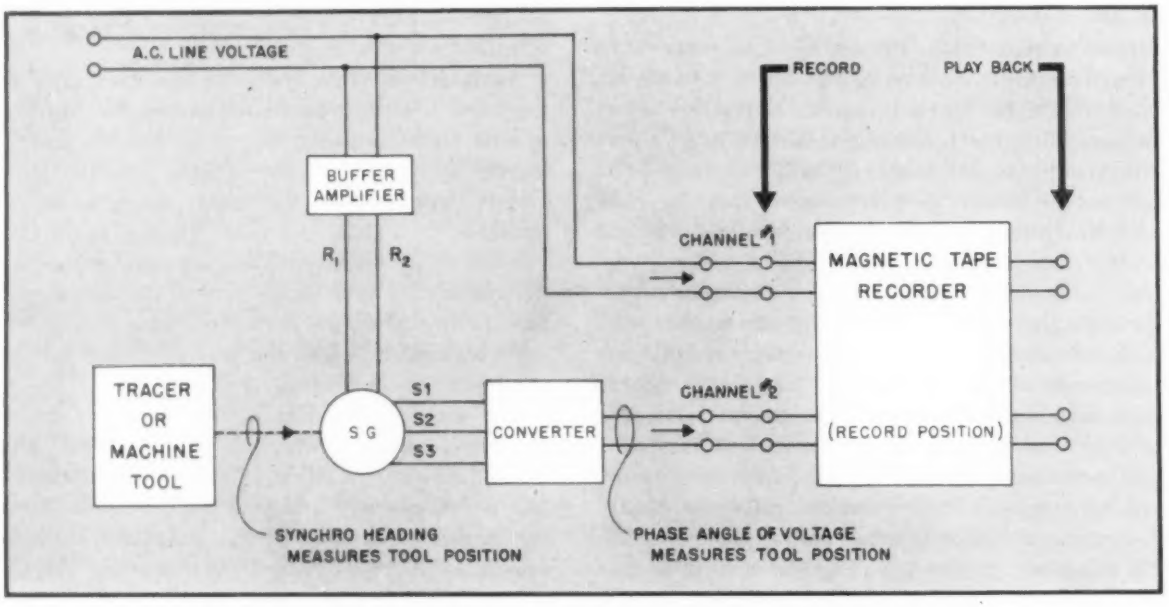


Fig. 6. Magnetic tape recording system for recording machine tool motion.

There are many alternative means for damping including the popular and inexpensive electric network damps.

Information Storage and Memory

The two separate functions of a suitable memory device are programming and supplying operating instructions. Programming has to do with the sequence of operations required for fabrication of a part. By means of special signals, the memory device must stop a tool at the completion of its cutting, withdraw it, and bring it or some other tool to bear in the next operation. The operating instructions from the memory unit supply the input order which tells the machine how much to cut and where.

In the manual control of machine tools, the operator applies his own information to the task of fabrication. The necessity for utilizing the human brain as a storage device has been eliminated in many production machines by the use of properly designed cam-actuated devices. Sequence programming is obtained by limit switches, timing devices, rotary switches driven by torgue motors upon the closing of contacts, relays, solenoids, etc.

Such methods, in widespread use today, suffer principally from their inflexibility. That is, high production is normally required to justify the most complete automaton which is scientifically possible.

The newer, more flexible memory devices are largely general purpose. A basic medium such as a magnetic drum or a punched tape is charged with information which may be converted by relatively standard devices to machine instructions. A roll of paper tape, for example, can have information stored in the form of holes punched by a typewriter-like machine. The translating device or tape reader applies a series of feeler wires to the punched paper, causing electrical connection to be made whenever a hole in the paper permits. The economy of performing a wide variety of machine operations on different manufactured parts by merely using a different roll of tape should encourage extension of automation to many medium production shops. The added convenience of being able to store a complete sequence of operations for possible future use on a compact role of tape is a striking one.

Some of the common storage media having these unusual properties are punched cards, punched tape, magnetic tape or wire, film, magnetic drums or disks, and dielectric storage devices. The first and the last two are peculiarly suited to digital computer application, and are not easily adaptable to machine control, although they may be used as overall programming elements. Punched tape

has the convenient feature that the recording of data is a typewriter operation, and is easily performed, although the mechanical nature of the pickup contacts limits the number of bits of information which can be handled per second. Accumulation of dirt in the holes, causing poor electrical contact, is frequently troublesome. Film taping does not have the serious speed limitation encountered in punched tapes. However, making film is at best an arduous task.

Magnetic Tape Memory: The magnetic tape is rapidly emerging as one of the most flexible information storage media available to the automatic control engineer. Equally adaptable to the storage of analog and digital information, and capable of containing a large density of information per unit volume, it promises to revolutionize many phases of the new factory automation field.[1*]

To a machine tool man, information storage means machines running by themselves, with motors, gears, and leadscrews set and actuated by the faint signals from a storage box. For simplicity, recording and playing back a shaft angle will be discussed, since all other mechanical motions can be expressed in terms of this.

The simplest approach might be to record the three voltages of a conventional synchro transmission unit, and later apply the recorded voltages to a receiver. Because of tape nonlinearity with signal amplitude, accuracy would be unsatisfactory for most purposes. Pickup between channels would also introduce error, and finally, three channels would be required for transmission of one angle. The three signal types which are most satisfactory for tape recording techniques are pulse-modulated signals, phase-modulated signals, and frequency modulated signals.

Pulse Modulated Signals: Pulse type signals may be derived from a shaft angle by means of an analog to digital converter. Data appears on the tape as a succession of pulses which is a code for the number corresponding to shaft angle. A variety of analog to digital converters is available commercially. In some systems, a number of separate recording channels are used, each corresponding to a digit of a multi-digit number. To pay for the extra channels, higher speed and economy of tape are required. Either decimal or binary notation may be used, although complicated coding procedures are needed to record decimal digits on tape. In the playback operation, the pulse data are reconverted to analog form. The controlled device orients itself in a succession of discrete steps corresponding to the pulsed information.

In addition to the above data, the tape may also contain pulses which program the operation sequence in a manufacturing process. This programmed information, generally contained on a separate channel, may be used to actuate solenoids, switches, and other devices normally requiring manual operation to insure rapid and accurate execution of requirements. Thus, an entire succession of machine tool operations may be controlled by the tape.

A valuable feature of tape control is the flexibility afforded in selection of tape speeds. Information may be played back at a rate commensurate with the machine tool capacity, thereby making for maximum production.

The outstanding difficulty in using tapes for pulse work is the occasional loss of a pulse resulting from nonhomogeneity. The principal causes of pulse drop-out are tape deflects such as particles of metal, foreign matter, pinholes or wrinkles, dust on the tape surface, mechanical flutter in tape drive, and accumulation of static charge.

The distressing feature is that the loss of even one pulse out of tens of thousands may be serious. The missing pulse can produce an irregularity in the machined piece, or it may even cause the omission of an important operation. Tape manufacturers are attacking the problem and tapes, especially prepared for use in machine control, are becoming available.

Phase-Modulated Signals: The analog approach features unusual flexibility and simplicity of parts, although it may not achieve the accuracy of digital methods. As noted previously, the most direct instrumentation would be to record synchro voltages on tape which could then be used to actuate the same or similar synchros during playback. The tape nonlinearity is the principal difficulty here. A method based on phase has been patented by E. W. Leaver et al[2], and an adaptation of that method is shown in *Figs.* 6 and 7.

The outstanding feature of this method is the almost complete absence of complex highly specialized parts. The recording system is shown in *Fig.* 6. A passive network or converter translates the synchro output, S_1-S_2-S_3, to constant-amplitude voltage whose phase is proportional to shaft rotation. This voltage and the synchro line voltage excitation are recorded on separate channels while an operator goes through a complete machining procedure on a part.

If desired, the record may be made from another synchro driven by a tracer or master machine. Any number of additional recordings may be made from an original. In *Fig.* 7 these voltages are played back. The shaft angle playback becomes an order to the machine tool servo which follows this order faith-

* Number refers to references to be listed at the end of the article next month.

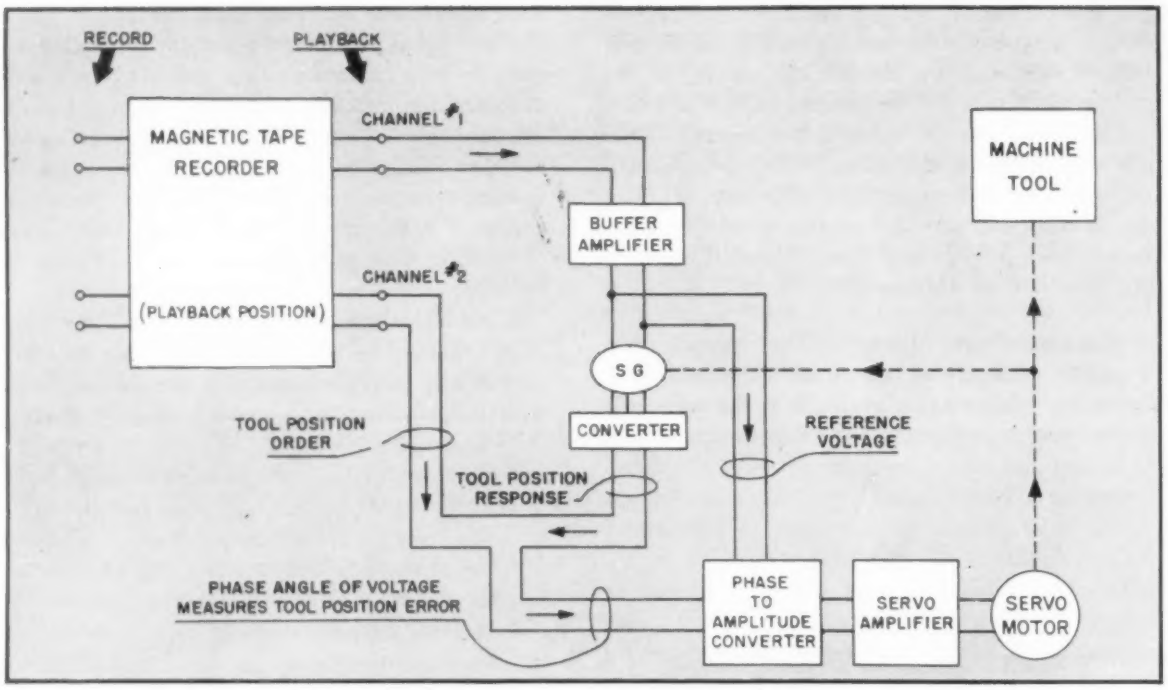


Fig. 7. Magnetic tape playback system for automatic machine tool control.

fully by virtue of the servomechanism shown in *Fig. 7*.

This method of recording is of particular advantage where a machine's motions are recorded under the control of a skilled machinist. This man knows the machine and will operate it in the right manner to obtain the greatest accuracy. He will naturally compensate for backlash, tool wear, tool spring, etc. Under playback this best operation will be repeated precisely.

An appealing virtue of the system is the relative insensitivity to tape irregularities. Nonhomogeneities simply result in noise or static which may be filtered out before they reach the machine tool. The servomechanism will help as explained earlier.

The accuracy depends directly on the relative phasing between signals in adjacent channels, and proper alignment of the recording head is essential if phase error is not to be introduced. This is easily incorporated as part of a zeroing procedure and should cause no difficulty. Accuracies of 1 to 2 degrees are possible with medium quality synchros. Multi-speeding by use of coarse and fine synchros can be incorporated where highest accuracy is required.

Sensitivity to carrier frequency is a limitation on this mode of information handling. Synchros are designed to operate over a limited frequency range and, if an operation speedup is desired by raising tape speeds, the carrier frequency will increase proportionally. Servo error will be introduced into the phase shift elements which may, however, be corrected by changing circuit values. A switch which simultaneously changes speed and readjusts circuit parameters is easily devised. A two or three-to-one speed range can be achieved with small loss in accuracy.

The patent of E. W. Leaver introduces an additional feature which permits simultaneous transmission of up to ten or twenty channels of information. The method consists of applying synchro signals as modulation to various carriers supplied by oscillators. These are sufficiently separated so that output filters may distinguish between them and direct them to the proper driving servos. This affords improvement in economy of tape channel.

Frequency-Modulated Signals: This is essentially another analog method but it has many distinguishing features. Shaft angle is converted to a resistance or capacitance variation in the circuit of an oscillator, thereby modifying its output frequency. The modulated frequency is recorded together with a reference oscillator frequency. Tape quality is relatively unimportant in this application since relative frequency should be maintained with absolute accuracy. A conventional fm detector can be used to convert the output to a signal of modulating frequency for ultimate reconversion to a shaft angle. The most significant advantage of this method is the almost complete independence of the signal transmission accuracy on the quality of either the tape or the audio circuits of the recorder.

Part 2 will discuss the application of these control techniques to machine tools.

(To be continued next month)

Titanium Carbide Alloys in Tooling*

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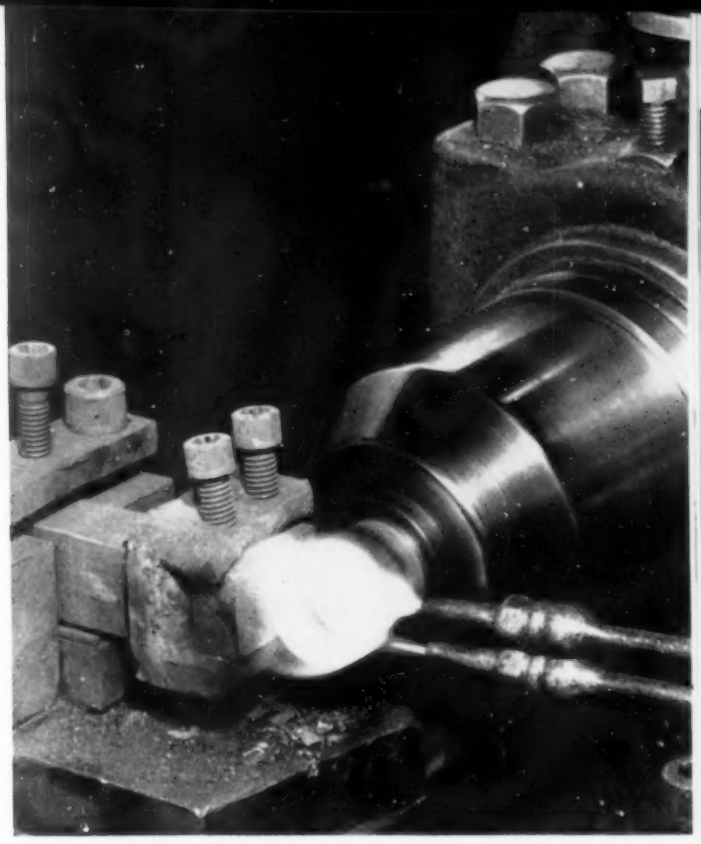

Fig. 1. Spinning closed a 1⅜-inch steel tube end heated by a gas flame. A titanium carbide block in the fixture is swung around by hand, forming a hemispherical end.

DEVELOPED PRIMARILY for components of jet engines, rockets and gas turbines, the titanium carbide alloys, with their unique combination of heat-resistant properties, high strength, thermal shock and oxidation resistance at temperatures of 1600 F and above, showed promise as a new tool material for certain difficult applications. An interesting application using these properties is shown in *Fig.* 1.

Properties: The most important properties of titanium carbide alloys are shown in TABLE 1 comparing them with tungsten carbides, the so-called "super alloys" of cobalt-chrome-nickel composition, and hardened steel. From the table, it is evident that properties of the titanium carbide alloys are quite different from any other engineering material.

DENSITY: Titanium carbide alloys have low density, about ⅔ that of steel and ⅓ to ½ that of tungsten carbide. This in itself is not unique but, when considered with good wear resistance, titanium carbides are proving to be useful tool materials.

HARDNESS: Hardness of these alloys is high, indicating good wear resistance. Although not quite so good as tungsten carbide alloys of the same hardness in this respect, they are superior to other metallic wear-resistant alloys at moderate temperatures and superior to any metallic alloy at temperatures over 1500 F.

YOUNG'S MODULUS OF ELASTICITY: In this respect, they are intermediate between steel and the harder tungsten carbide alloys. The high stiffness results in low distortion under load. At room temperature titanium carbides have only small permanent deformation under load. The elastic limit and ultimate strength being so close together, failure from overloading usually results in breakage rather than permanent distortion. At elevated temperatures some plastic flow is possible under loads in excess of the elastic limit.

THERMAL EXPANSION: Titanium carbides are below steel but higher than tungsten carbide alloys. Compared with cobalt-chrome-nickel alloys they are low. One gage manufacturer reports that titanium carbide alloys have a higher thermal expansion rate than any other hard carbide alloy in the range of 70–90 F.

THERMAL CONDUCTIVITY: Low compared to steel, titanium carbides are about the same as steel-cutting types of tungsten carbide alloys, but well above cobalt-chrome-nickel alloys or refractory cera-

* Abstracted from paper 21T15, "Tool Engineering Applications of Titanium Carbide Alloys," presented before the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society Headquarters.

† Senior member of ASTE Pittsburgh chapter.

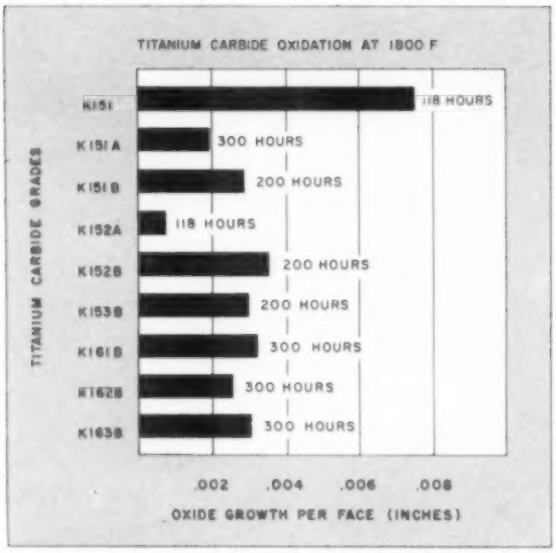

Fig. 2. Titanium carbide oxidation at 1800 F in relation to time.

mics. This property, together with relatively low thermal expansion makes titanium carbides more resistant to thermal shock than the super alloys or ceramics.

TENSILE STRENGTH: Tensile strength of titanium carbides is unimpressive at room temperature, but outstanding in the range of 1600 F and over.

OXIDATION RESISTANCE: While straight titanium carbide-nickel alloys are good in this respect, much better oxidation resistance is achieved by the addition of a few percent of other refractory metal carbides. As shown in *Fig.* 2, these modified alloys of titanium carbide withstand 300 hours at 1800 F in an oxidizing atmosphere with only 0.001 to 0.003 oxide growth on the surfaces. The rate of oxidation decreases rapidly after the tenacious oxide coating is formed.

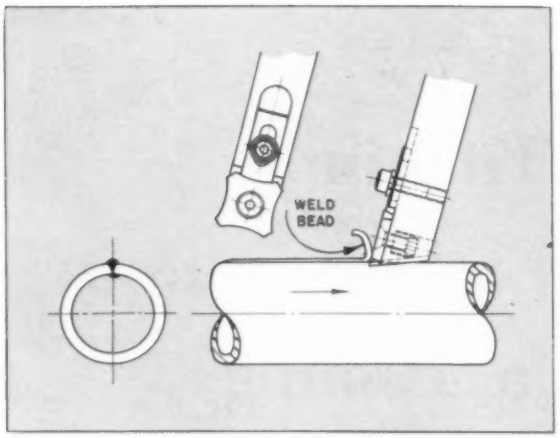

Fig. 3. Tool with a titanium carbide insert removing weld bead from tubing at 1200 to 1500 F.

Metal Cutting: Since titanium carbide alloys have no outstanding metal-cutting characteristics at normal machining temperatures, their field of application is in hot operations. One such use is shown in *Fig.* 3. On a series of tests, the titanium carbides proved superior to tungsten carbide or multiple carbide compositions for this job, completing the longest single run and setting the highest average footage per grind. Since initial tests, the use of titanium carbides for flash trim has become standard practice in several tube mills.

A similar application is hot machining a steel workpiece which is heated rapidly to a surface temperature of about 1600 F just ahead of the tool to increase the rate of metal removal, reduce power and tool thrust, and improve finishes. On one test

Table 1—General Characteristics of Typical Titanium Carbide Compositions

	PROPERTY	TITANIUM CARBIDE (Kentanium) Composite properties of grades, using 10 to 40 percent nickel binder	TUNGSTEN CARBIDE (Kennametal) Standard Grades	SUPER ALLOYS Range for several Co-Cr-Ni, and high Ni-Cr Alloys	HARDENED STEEL
ROOM TEMPERATURE	Density (gms/cc)	5.5 to 6.5	11.9 to 15.1	8.3 to 8.7	7.8
	Hardness (Rockwell A)	83 to 93	85 to 93	61 to 65	83 max.
	Modulus of Elasticity (psi) (Representative values)	55,000,000	61,000,000 to 94,000,000	30,000,000	29,500,000
	Compressive Strength (psi)	550,000	518,000 to 800,000	———	500,000
	Conductivity, Thermal (cal/ C/cm/sec)	.072 to .085	.068 to .207	.035 to .065	.140
HIGH TEMPERATURE	Thermal Expansion (in/in/F x 10^{-6} to 1200 F)	4.3 to 5.8	2.5 to 4.0	6.73 to 8.5	8.2
	Oxidation Resistance 1800 F	Excellent (See Fig. 2)	Poor	Good	Poor
	Tensile Strength, (psi) at 70 F	80,000 to 137,000 (representative)	100,000 to 150,000	110,000 to 180,000	280,000
	1500	55,000	(Not suitable for high temperatures)	52,000 to 73,000	(Not suitable for high temperatures)
	1600	47,000		34,000 to 51,000	
	1800	40,000		9,000 to 25,500	
	2000	30,000		13,100	
	2200	12,500		———	
	2400	3,000		———	

run recently, a titanium carbide grade produced thirty times the life of a conventional tungsten carbide grade, and three times the life of the best standard cutting grade of carbide.

Chip removal operations at elevated temperatures do not involve high tool loadings as the steel being cut has relatively low shear strength at these temperatures, but thermal shock and high temperature abrasion are severe.

Metal Forming: A good example of the possibilities of forming hot metal with titanium carbides is in tube spinning, *Fig.* 1. The tube is rotated at 600 rpm and a uniform $\frac{3}{8}$-inch hole is produced for subsequent finishing. In this case the titanium carbide operates for 15 to 20 hours before regrinding is necessary to remove the wear cavity. Thermal cracking is seldom encountered.

Another spinning operation on smaller tubing is shown in *Fig.* 4. An average of 3,000 parts are produced per dressing, four or more grinds being possible on each insert. The cycle time is just half that required with the next best material. The finish produced is excellent.

Dies: Dies of titanium carbides for hot extruding of aluminum, magnesium and copper alloys look promising but, while some excellent runs have been made, there are still some problems to be solved. Proper holding of the die insert in a steel plate or case of much higher coefficient of thermal expansion, requires unique designing when wide temperature changes are encountered.

Tong Points and Guides: Closely akin to metal-forming applications are uses as tong points and guides in steel mills. In the operation shown in *Fig.* 5 jets of water, required to protect the grooved rolls and to prevent overheating of the rod being reduced, result in an extreme thermal shock condition. The tendency of the work to weld to the guides limited these parts to cast brass in the past, with relatively fast wear and short life. Using titanium carbide guide inserts, life is extended tenfold or more. Better work is produced with less down time for guide changes or clearing tangles due to cobbled rod. On mills with hundreds of tons capacity per day, savings are substantial.

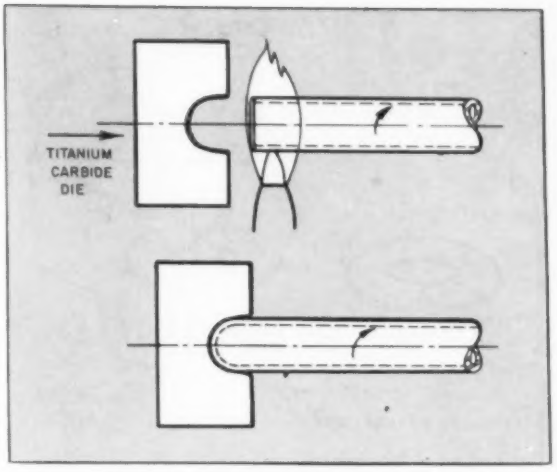

Fig. 4. Spinning tool with titanium carbide U-shaped insert is fed over the end of $\frac{3}{8}$-inch diameter steel tubing at 2000 F, completely closing the tube.

Tong points are conical inserts with a tapered body, used to penetrate hot billets or ingots of steel sufficiently to permit crane tongs to lift the heavy, white-hot masses out of soaking pits and transport them to rolls, hammers, presses, conveyors, etc. Titanium carbide points are proving ideal for the combination of thermal shock and oxidation resistance, plus high temperature shear stress required.

Jigs and Fixtures: The difficulty of welding, brazing or soldering to a surface of titanium carbide alloy, without special surface coatings, sometimes complicates a problem of parts fabrication but, in tooling, this property is a real asset. As an anvil, *Fig.* 6, against which tin plated sheet steel is pressed during a spot-welding operation, it prevents pickup of molten steel which could puncture subsequent parts and spoil the gas-tight seal desired.

On heavier 20-gage sheet, small blocks used as wear-resistant strips regulate the amount of overlapping of edges on steel drums during welding. The strips are within the field of an induction heating coil and are subject to intermittent heating, as

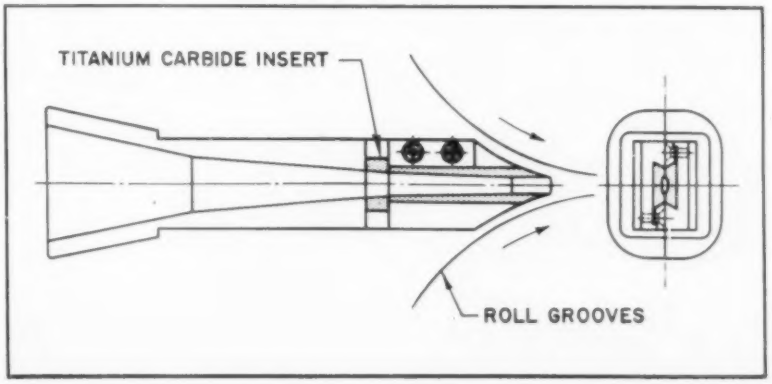

Fig. 5. Titanium carbide insert, mounted in working end of rod mill guide, to feed hot steel rod on edge at high velocity into the roll grooves.

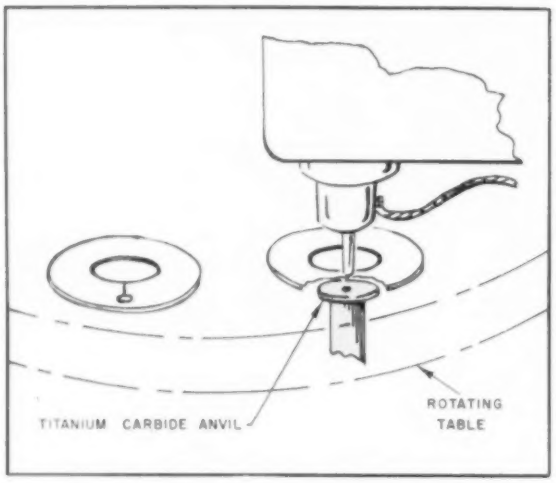

Fig. 6. Titanium carbide anvil used in spot-welding operation to resist heat and avoid metal pickup.

well as wear, yet must not weld to the sheet steel.

In a lower temperature range, titanium carbide supporting pads are used to hold sheet steel fabricated containers while lead solder is furnace melted into the spot-welded seams. Aluminum pads resisted tinning by the lead solder, but wore and warped rapidly. Titanium carbide provides the desired resistance to tinning and excellent wear and warping life.

Other jig and fixture applications include racks and positioning pins for holding parts during furnace operations of brazing, ceramic firing, heat treating, etc., in a variety of atmospheres, temperatures and loading which are destructive to the usual high chrome-nickel alloys. The support pins and points of titanium carbide shown in *Fig.* 7 resist the fluxing action of ceramic oxides and provide the high temperature strength required to support loads involved.

Gages: Even at room temperature, the combination of properties of titanium carbide alloys makes them suitable for many gage applications. The high hardness, lightweight, corrosion resistance and thermal expansion rate approaching that of steel make it an excellent material for gages. At 5.1 expansion rate per degree Fahrenheit it is somewhat lower than steel, but better than tungsten carbide alloys with a maximum of 4.0. Lightweight plug and ring gages, thread gages and similar hand-operated checking devices permit a more sensitive touch and reduces operator fatigue. On one continuous automatic gaging application with ring gages, the low inertia resulting from light weight increases sensitivity and speed of response of the instrument while the hardness permits long life; the strength prevents breakage or chipping encountered with ceramic type rings.

Use of titanium carbide balls for Brinell hardness testing at temperatures above 1200 F has added to the knowledge of high temperature properties of various alloys. Runs of 100 tests over a period of 100 hours at heat have been made without measurable change in ball diameter or performance. No previous material was practical for such work. At 1100 to 1200 F a tungsten carbide ball was good only for one to five impressions.

Conclusion: In addition to these tooling applications, new uses are continually developing and new variations in alloys are widening the scope of application. As the properties of titanium carbides become better known, tool engineers will no doubt find increasing use for them.

Fig. 7. Titanium carbide support pins (above) for use in porcelain enameling furnaces and tong points (below) for hanging plate glass during tempering.

METAL-CUTTING with Wax Lubricants*

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ANY DISCUSSION OF WAX or waxes and their uses must necessarily begin with an attempt to establish common ground for the meaning of the word wax. A multitude of materials have been given the name wax so that accurate definition is all but impossible. For simplification, it can be said that all waxes, regardless of source, have these properties in common:

1. They are usually solid at room temperature.
2. They exhibit adhesive properties toward surfaces to which they are applied.
3. They are cohesive in that they adhere to themselves in cold molding.
4. They are plastic solids having plastic flow.
5. They are essentially insoluble in water, but soluble in organic solvents.
6. They are capable of being buffed to a polish.

The first use of wax in the formulation of a metalworking lubricant or cutting fluid must have been prompted by a desire to provide definite characteristics. Some waxes do have properties which are useful and, indeed, badly needed in metalworking. The ever growing demand for better lubricants and cutting fluids serves continually to emphasize the importance of these qualities:

1. Lubricity (the ability to reduce frictional resistance) at high temperatures.
2. Lubricity at very high pressures.
3. Polarity.

It is said that the three properties most needed in metalworking lubricants today are pressure resistance, temperature resistance and adhesion. Fluid lubrication at 200,000 psi, or at 450 F are both valuable contributions to the industry. However, polarity is even more important.

The theory of polar adsorption is gaining substantial acceptance in the literature. Consider the atoms which make up the metallic solid of the tool or the piece to be worked. When the atoms of the metal crystallize into a solid mass they join tightly together as a result of the attraction which they have for one another.

Electrical charges, that constitute the attractive forces of those atoms within the interior of the metallic mass, are all balanced by the attractive forces of the atoms about them. Here the outermost atoms have no similar atoms beyond them, and these unsatisfied electrical forces of the surface atoms, tiny though they may be, all combine to form a field of influence, electrical in nature, at the metallic surface.

Such a field is capable of attracting certain other substances. This attraction is called polar adsorption, the metal surface serves as the adsorbent, holding the adsorbate upon its surfaces. It is necessary, however, if the metal surface is to strongly exercise this quality of polar adsorption that the adsorbate, in this case the active agents of the coolant or lubricant, possess similar characteristics of attraction or polarity.

It has been found that certain specific ingredients possess the type of attractive electrical forces which, when incorporated in a coolant or lubricant, are

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Table 1 — Cutting Fluid Performance for Turning Steel (Short-Time Test)

Test No.	Cutting Fluid	Tool Wear (in.)		Tool Force (lbs)		Surface Roughness*
		Corner	Side	Cutting	Feeding	
1	Dry cutting	.0086	.0023	283 (100%)	218 (100%)	3
2	Anionic emulsion of proprietary wax blend A: 1—20	.0053	.0019	271 (96%)	188 (86%)	5
5	Carbowax soln. 1—20	.0034	.0054	278 (98%)	189 (87%)	6
6	Water soluble Ucon lubricant 1—20	.0045	.0023	298 (105%)	177 (81%)	2
7	Commercial cutting fluid: 1—20	.0093	.0074	296 (104%)	184 (85%)	4
8	Commercial soluble oil: 1—20	.0046	.0040	277 (98%)	178 (82%)	7
9	Carbon tetrachloride, only ½ minute	.0033	.0036	238 (84%)	152 (75%)	1

*1, best; 7, roughest. There was only a slight difference between the best and the roughest surfaces.

adsorbed on the metal surface of the work and tool. Here they are held tenaciously during the working process.

In exploring the use of waxes in lubrication, basic research and comparative tests have repeatedly proved that specific requirements can be met only by materials with predetermined characteristics. Categorical use of waxes is useless and meaningless.

Whether or not a material is wax is not the sole criterion; its chemical structure will be the determining factor in accepting or discarding it for use in a lubricant or cutting fluid. The word wax carries the same value here as does the word wood to the furniture builder, or the word metal to the automobile manufacturer. At best, it describes a broad class of materials.

Having discovered some years ago that one commercial wax product performed surprisingly well on a certain lubricating job, it was interesting as well as disturbing to learn that other similar products worked poorly or not at all. A cut and try investigation of waxes by type and waxes by source resulted in a number of promising starts and an equal number of dead ends, and it prompted the decision to enter a research program to explore the basic, simple functions and principles of metalworking lubricants as related to the entire subject of waxes.

One item of information turned up by this study was worth the entire effort. Ingredients can be chemically identified which, in combination, form a base possessing the properties necessary for high pressure, high temperature lubrication, even though these same specific ingredients are not useful individually. Each of these dissimilar materials augments the value of the other so that, in combination, their value is far greater than the sum of their respective values.

Table 2 — Cutting Fluid Performance for Turning Aluminum (Short-Time Test)

Test No.	Cutting Fluid	Tool Force (lb)		Surface Roughness*
		Cutting	Feeding	
10	Dry cutting	218 (100%)	186 (100%)	1
11	Anionic emulsion of proprietary wax blend A: 1—20	94 (43%)	46 (25%)	2
12	Carbowax soln. 1—20	125 (57%)	67 (36%)	4
13	Ucon lubricant 1—20	117 (54%)	63 (34%)	6
14	Commercial cutting fluid: 1—20	122 (56%)	70 (38%)	7
15	Commercial Soluble oil: 1—20	107 (49%)	61 (33%)	5
16	Carbon tetrachloride, only ½ minute	82 (38%)	27 (15%)	3

*1, best; 7, roughest.

One phase of the research program was a series of tests performed by the University of Michigan Engineering Research Institute. The accompanying tables summarize the results of these tests. It should be emphasized that these tests were an early phase of the investigation and were purely screening tests, concerned primarily with raw materials, rather than with finished products. It will, therefore be noted that some combinations show up employing seemingly useless materials. Carbon tetrachloride was used throughout these tests as a control material of established value.

The commercial fluids were selected by the University staff as typical examples of high-quality products in their fields. Except for the carbon tetrachloride and two of the three commercial products, none of the experimental materials tests were identified to the staff.

All turning tests were run with 18-4-1 HSS tools having 0 degrees back rake, 8 degree side rake, 7 degree end relief, 7 degree side relief, 30 degree end cutting edge, 0 degree side cutting edge, 0.036 inch wide chamfer at 60 degrees. All forces were measured by dynamometer using wire resistance strain gages, electronic strain amplifiers and recording oscillographs. A toolmaker's microscope was used to measure tool wear. All force values are relative to the forces obtained when cutting dry which is assigned the value of 100 percent.

TABLE 1. This data covers a turning test on SAE 1018 steel. With each fluid this test was stopped after 1, 6, 11, 16 and 20 minutes to observe tool wear. Tool wear figures shown are for the full 20-minute run. Depth of cut was 0.100 inch; feed, 0.012 inch per revolution; cutting speed 25 feet per minute.

Carbon tetrachloride, although it was run for only ½ minute, produced the lowest force values for both cutting and feeding as well as the best finish. The tool wear figures are interesting. Commercial fluid

Table 3 — Relative Forces

	Cutting Fluid	Turning SAE 1018		Turning 25 Al		Turning S.S. 304		Tapping SAE 1018					Milling SAE 1018	Drilling S.S. 304	Reaming S.S. 304	Reaming SAE 1018
		Cutting Force	Feed Force	Cutting Force	Feed Force	Cutting Force	Feed Force	Spiral Point Blind	Spiral Point Thru Max.	Spiral Point Thru Avg.	Std. Point Max.	Std. Point Avg.				
1	Dry	100	100	100	100	100	100	100	100		100		100	100	100	100
2	Anionic emul. of prop. wax blend A	96	86	43	25	88	88	103	97	86	83	74	85	106	93	80
3	Carbowax soln.	98	87	57	36	88	85	102	109	102	79	77	92	111	93	116
4	Ucon Lubricant	105	81	54	34	88	85	118	112	98	63	62	85	119	107	116
5	Commercial cutting fluid A	104	85	56	38	88	85	118	102	97	75	63	89	111	93	104
6	Commercial soluble oil	98	82	49	33	97	97	110	88	85	53	49	88	112	102	108
7	Prop. wax blend C in halogenated hydrocarbon	—	—	36	20	86	79	143	70	59	51	51	82	90	75	65
	20:1 S.S.	—	—	—	—	(3:1) 90	76	—	67	54	71	68	—	88	70	—
	10:1 S.S.	—	—	—	—	(1:1) 83	76	—	85	67.85	67	66	—	—	—	—
8	Anionic emul. of prop. wax blend B	105	89	37	27	86	82	138	100	91	59	58	—	105	84	94
9	Carbon tetrachloride	84	75	38	15	79	64	107	85	73	38	32	81	85	79	111

(No. 7) produced more tool wear even than dry cutting; commercial soluble oil (No. 8) produced excessive side wear, but fairly low corner wear and good force values. The anionic wax emulsion (No. 2) produced very low side wear and the best cutting force value excepting carbon tetrachloride. Water soluble Ucon lubricant (No. 6) and commercial fluid (No. 7) produced cutting force values poorer than dry cutting. Surface finish values are relatively unimportant in this test since there was only a slight difference between the best and the worst.

TABLE 2. This is a summary of a turning test on annealed 2S aluminum using the same fluids as shown in TABLE 1. No tool wear figures were compiled because of the slight difference produced by aluminum on short run tests. Depth of cut was 0.100 inches; feed, 0.0075 inches per revolution; cutting speed, 25 feet per minute.

All fluids were effective on 2S aluminum; even the least effective reduced cutting forces by better than 40 percent. Anionic wax emulsion (No. 11), which produced excellent values on SAE 1018 steel in TABLE 1, again produced lowest force values, excepting carbon tetrachloride, which was run only ½ minute. Also, commercial fluid (No. 14) which produced very poor values on SAE 1018 steel, TABLE 1, also produced relatively poor values. Commercial soluble oil (No. 15) produced good force values as it did on 1018 steel. Although all fluids were more effective on aluminum than on 1018 steel, they produced about the same relative values on both materials.

Table 4 — Turning Forces for Cutting Stainless Steel

Cutting Fluid	Tangential Force (lb.)	%	Feeding Force (lb.)	%	Coef. of Friction	Group
DRY						
WATER EMULSIONS	216 avg.	100	165 avg.	100	1.01	—
1. Oxidized petrolatum 1:20	180	83	135	82	.99	C
2. Petroleum sulfonate 1:20	210	97	135	82	.86	E
3. Petroleum sulfonate & mineral oil 1:20	190	88	140	85	.98	D
4. Ester type wax emulsion 1:20	190	88	135	82	.95	D
5. Chlorinated cyclic hydrocarbon 1:20	175	81	125	76	.96	B
6. Sulphurized sperm oil 1:20	185	86	135	82	.96	D
7. Emulsion of oxidized hydrocarbon wax & fatty acid 1:10	155	72	110	67	.94	A
8. Oleyl alcohol 1:10	175	81	140	85	1.07	C
9. Lanolin 1:20	190	88	140	85	.98	D
10. Steryl alcohol 1:5	190	88	140	85	.98	D
11. Proprietary wax blend C in halogenated 1:10	200	93	150	91	.98	E
hydrocarbon 1:35	195	90	145	88	.98	D
SOLVENT TYPES						
12. Proprietary wax blend D in mineral oil	190	88	150	91	1.05	E
13. Proprietary wax blend C in halogenated	185	86	130	79	.93	C
hydrocarbon 1:1	180	83	125	76	.93	B
14. Proprietary wax blend C in high flash naphtha	170	79	130	79	1.01	B
15. Proprietary wax blend C in carbon tetrachloride	162	75	100	61	.88	A
16. Proprietary wax blend C in sulphurized sperm oil: Stoddard	180	83	132	80	.98	C
solvent 1:1	175	81	140	85	1.07	C
17. Proprietary wax blend C in sulphurized mineral oil: Stoddard solvent 1:1	180	83	125	76	.93	B
	180	83	140	85	1.03	C
18. Proprietary wax blend E: Stoddard solvent 2:1	185	86	140	85	1.01	D
	185	86	150	91	1.07	E

TABLE 3. This is a composite chart of the results of the tests shown on TABLES 1 and 2, plus additional turning tests on 304 stainless steel, tapping SAE 1018 steel, milling SAE 1018 steel, drilling and reaming 304 stainless and reaming SAE 1018. The table shows only relative force values. Carbon tetrachloride is again an outstanding performer, and all fluids produced poorer values than did dry cutting in blind hole tapping, indicating that these fluids only aggravate the already serious problem of chip interference in blind holes.

This series of tests, for the first time, shows carbon tetrachloride being equalled and even surpassed in some cases. Proprietary wax blend *C* (No. 7) produced excellent values in turning aluminum and turning stainless steel, better than carbon tetrachloride (No. 9) in tapping with spiral point tap. Too, it was excellent with a standard point tap and equal to carbon tetrachloride in milling SAE 1018. Only carbon tetrachloride (No. 9) and proprietary wax blend *C* (No. 7) produced low values in drilling and reaming 304 stainless. Proprietary wax blend *C* (No. 7) alone produced a very low value in reaming SAE 1018. It is interesting to note how many values over 100 show up on this chart, even excluding blind hole tapping. Commercial cutting fluid *A* (No. 5) produced consistently poor values whereas the values for commercial soluble oil were generally good.

The most noteworthy aspect of this table is the consistent pattern of excellent values produced only by carbon tetrachloride (No. 9) and proprietary wax blend *C* in halogenated hydrocarbon (No. 7).

TABLE 4. This is the first of three charts covering the results of turning tests with another group of fluids. Some strange combinations show up, but each fluid is used for a purpose. These charts show not only force values but also a coefficient of friction value and a group classification to indicate overall performance. The coefficient of friction is computed as follows:

$$\mu = \frac{\text{Feeding force} + [\text{Cutting force} \times \text{Tan of Side rake angle}]}{\text{Cutting force} - [\text{Feeding force} \times \text{Tan of Side rake angle}]}$$

The alphabetical performance classification was set up by the University of Michigan staff as follows:

A — Fluids produced excellent results.
B — Fluids produced very good results.
C — Fluids produced good results.
D — Fluids produced poor results.
E — Fluids produced least, if any, force reduction.

Tests in TABLE 4 were run on 304 stainless steel. Note again the excellent performance of carbon

Table 5—Turning Forces for Cutting

Cutting Fluid	Cutting Forces (lbs.)	Cutting Forces Percent	Feeding Forces (lbs.)	Feeding Forces Percent	Burr	Chip	Coef. of Friction	Group
DRY	168 avg.	100	150	100	Heavy	Thick	1.08	—
WATER EMULSIONS								
1. Oxidized petrolatum 1:20	61	36	43	29	Med.	Thin	.95	C
2. Petroleum sulfonate 1:20	78	46	55	37	Med.	Med.	.94	D
3. Petroleum sulfonate + mineral oil 1:20	72	43	55	37	Med.	Med.	1.02	D
4. Ester type wax emulsion 1:20	57	34	36	24	Light	Thin	.85	C
5. Chlorinated cyclic hydrocarbon 1:20	68	41	49	33	Light	Thin	1.07	D
6. Sulphurized sperm oil 1:20	63	38	43	29	Light	Thin	.91	C
7. Emulsion of oxidized hydrocarbon wax + fatty acid 1:10	60	36	42	28	Light	Thin	.93	C
8. Oleyl alcohol 1:20	59	35	40	27	Light	Thin	.90	C
9. Lanolin 1:20	64	38	45±	30±	Light	Thin	.93	D
10. Steryl alcohol 1:5	68	41	45+	30+	Med.	Med.	.89	D
11. Proprietary wax blend C in halogenated 1:10	71	42	46	31	Light	Med.	.86	D
hydrocarbon 1:35	76	45	51	34	Med.	Med.	.90	D
SOLVENT TYPES								
12. Proprietary wax blend D in mineral oil (too thick)	50	30	32-24	21-16	None	Thin	.66-.85	B-C
13. Proprietary wax blend C in halogenated hydrocarbon:	44	26	12	8	None	Thin	.43	A
Stoddard solvent 1:10	50	30	21	14	Light	Thin	.60	B
14. Proprietary wax blend C in high flash naphtha	42	25	17	11	None	Thin	.58	A
15. Proprietary wax blend C in carbon tetrachloride	40	24	9	6	None	Thin	.38	A
16. Cane oil	57	34	40	27	Light	Med.	.94	C
17. Proprietary wax blend C in sulphurized sperm oil (too thick)	Var	Var			Heavy	Thick	—	—
Stoddard solvent 1:1	51	30	66	44	Heavy	Thick	1.74	E
18. Proprietary wax blend C in sulphurized mineral oil (too thick):	52	31	36	24	Medium	Thick	.92	C
Stoddard solvent 1:1	42	25	12	8	None	Thin	.45	A
19. Carbon tetrachloride	44	26	10	7	None	Thin	.37	A

Table 6—Turning Forces for Cutting Steel

Cutting Fluid	Tangential Force (lbs.)	%	Feeding Force (lbs.)	%	Coef. of Friction	Group
DRY	228 avg.	100	157 avg.	100	.92	..
WATER EMULSIONS						
1. Oxidized petrolatum 1:20	220	96	145	92	.88	D
	230	101	160	102	.92	E
2. Petroleum sulfonate 1:20	225	99	160	102	.95	E
	240	105	165	105	.92	E
3. Petroleum sulfonate plus mineral oil 1:20	235	103	160	102	.91	E
	240	105	170	108	.94	E
4. Ester type wax emulsion 1:20	215	94	145	92	.90	D
	235	103	155	99	.88	E
5. Chlorinated cyclic hydrocarbon 1:20	220	96	140	89	.86	D
	215	94	145	92	.90	D
6. Sulphurized sperm oil 1:20	225	99	150	96	.89	E
	225	99	150	96	.89	E
7. Emulsion of oxidized hydrocarbon wax plus fatty acid 1:10	230	101	150	96	.87	E
	230	101	155	99	.90	E
	230	101	155	99	.90	E
8. Oleyl alcohol 1:20	235	103	155	99	.88	E
	225	99	150	96	.89	E
9. Lanolin 1:20	230	101	155	99	.90	E
	235	103	155	99	.88	E
10. Steryl alcohol 1:5	230	101	155	99	.90	E
11. Proprietary wax blend C in halogenated hydrocarbon 1:10	215	94	135	96	.84	D
1:35	220	97	155	99	.94	E
	220	97	155	99	.94	E
12. Proprietary wax blend D in mineral oil	210	92	155	99	.98	D
13. Proprietary wax blend E	195	86	125	80	.96	C
14. Proprietary wax blend C in halogenated hydrocarbon	180	79	115	73	.84	B
15. Proprietary wax blend C in high flash naphtha	200	88	135	86	.90	C
16. Proprietary wax blend C in carbon tetrachloride	145	64	70	45	.67	A
17. Proprietary wax blend C in sulphurized sperm oil	225	99	150	96	.89	E
18. Proprietary wax blend C in sulphurized mineral oil	190	83	120	76	.85	B
19. Cane oil	215	94	145	92	.90	D
20. Carbon tetrachloride	173	76	117	75	.84	B

Table 7—Turning Forces for Cutting Aluminum

Cutting Fluid	Tangential Force (lb)	%	Feeding Force (lb)	%	Coef. of Friction	Group
Dry (Avg.)	208	100	196	100	1.25	..
1. Carbon Tetrachloride (Avg.)	71	34	25	13	.52	B
2. Wax ester emulsion A (Avg.)	93	45	57	29	.91	D
1:1	95	46	54	28	.77	D
1:12	100	48	68	35	.91	D
3. Wax ester emulsion B	72	35	43	22	.80	C
1:1	75	36	40	20	.73	C
1:12	90	43	56	29	.84	D
4. Compounded mixture of animal, vegetable and mineral waxes in halogenated hydrocarbon	69	33	23	12	.50	B
1:1	59	28	18	9	.46	A
1:5	68	33	22	11	.49	B
5. Refined wax ester in paraffin oil 1:1	74	36	59	30	1.05	C
	90	43	Var	..	..	..
6. Refined wax ester in halogenated hydrocarbon	68	33	30	15	.63	B
1:1	67	32	22	11	.48	B
7. Modified wax ester in paraffin oil 1:1	101	49	117	60	1.54	E
	Var	..	Var	..	..	..
8. Modified wax ester in halogenated hydrocarbon	77	37	51	26	.87	C
1:1	68	33	25	13	.55	B
1:2	64	31	22	11	.51	B
1:5	61	29	17	9	.41	A
1:10	62	30	15	8	.40	A
9. Modified wax ester in paraffin oil	60	29	26	13	.61	B
1:1	63	30	23	12	.57	B
1:5	70	34	27+Var	14+	..	C
10. Proprietary wax blend C in halogenated hydrocarbon	56	27	21	11	.55	A
1:10	66	32	23	12	.53	B
	62	30	18	9	.46	A
11. Halogenated hydrocarbon	63	30	17	9	.43	A
12. Paraffin oil	66	32	21	11	.48	B
1:1	88	42	45	23	.92	D
1:5						

tetrachloride (No. 15) and the really excellent values produced by the emulsion of oxidized hydrocarbon wax plus fatty acid (No. 7). All other emulsions produced consistently poor results except chlorinated cyclic hydrocarbon (No. 15), which was quite good. Among the solvent types proprietary wax blend *C* (No. 13) again was consistently good in several different vehicles.

TABLE 5. The results of this test on annealed 2S aluminum show, as in previous aluminum cutting tests, that all fluids were effective. However, emulsions as a group produced poorer values than did the solvent types. The emulsion of oxidized hydrocarbon wax plus fatty acid (No. 7), which showed excellent results on 304 stainless, was one of the best of the emulsions. Several of the solvent type fluids produced excellent values as did pure carbon tetrachloride (No. 9). Values for sulphurized sperm oil (No. 17) were definitely poorer than for sulphurized mineral oil (No. 18).

TABLE 6. This table covers the same test on SAE 1018 steel. Proprietary wax blend *C* in halogenated hydrocarbon (No. 11) was the best of the emulsions, but emulsions as a group again produced poorer values than solvent types. Ester type wax emulsion (No. 4) which was quite good in TABLES 4 and 5 is also one of the best here, showing an overall trend on the three metals to be better than average. Here proprietary wax blend *C* produces widely varying values in different vehicles. In water emulsions (No. 11) it is good as emulsions go; in halogenated hydrocarbon (No. 14) it is good; in high flash point naphtha (No. 15) it is fair; in carbon tetrachloride (No. 16) it is excellent. Proprietary wax blend *C* in carbon tetrachloride (No. 16) produced decidedly better values than did carbon tetrachloride (No. 20) alone.

TABLE 7. This is another turning test on annealed 2S aluminum with another group of fluids. Several fluids containing wax produced better values than carbon tetrachloride on this chart: note compounded mixture of animal, vegetable and mineral waxes in halogenated hydrocarbon at 1:1 (No. 4), modified wax ester in halogenated hydrocarbon (No. 8) at 1:5 and 1:10, and proprietary wax blend *C* in halogenated hydrocarbon (No. 10) at 1:5 and 1:10. This chart shows some interesting results produced by dilution. The emulsions seemingly are not materially affected by changing the dilution from 1:1 to 1:12, (Nos. 2 and 3). Modified wax ester ap-

Table 8—Turning Forces for Cutting Steel

Cutting Fluid		Tangential Force (lb)	%	Feeding Force (lb)	%	Coef. of Friction	Group
Dry	(Avg.)	246	100	169	100	.92	..
1. Carbon tetrachloride	(Avg.)	208	85	123	73	.80	B
2. Water ester emulsion A		245	100-	170	101	.92	E
	1:1	240	98	150	89	.84	D
	1:12	250	102	175	103	.93	E
3. Wax ester emulsion B		230	94	145	86	.84	D
	1:1	230	94	150	89	.87	D
	1:12	255	104	180	106	.94	E
4. Compounded mixture of animal, vegetable & mineral waxes	(Avg.)	210	85	125	74	.81	B
in halogenated	1:1	205	89	125	74	.82	C
5. Refined wax ester in paraffin oil	1:1	235	96	150	89	.86	D
		235	96	150	89	.86	D
6. Refined wax ester in halogenated hydrocarbon	1:1	210	85	120	71	.78	B
		220	89	135	80	.83	C
7. Wax ester plus alkaline soaps in paraffin oil	1:1	255	104	175	103	.92	E
		240	98	170	101	.95	E
8. Modified wax ester in halogenated hydrocarbon	1:1	210	85	120	71	.78	B
		210	85	115	68	.75	B
9. Modified wax ester in paraffin oil	1:1	215	87	125	74	.79	B
		230	94	130	77	.76	C
10. Proprietary wax blend C in halogenated hydrocarbon	1:1	230	94	150	89	.87	D
	1:4	215	87	135	80	.84	C
	1:10	205	83	125	74	.82	B
		210	85	120	71	.78	B

pears to be progressively improved by increasing dilution in halogenated hydrocarbon (No. 8) although halogenated hydrocarbon alone (No. 11) produced much poorer results. Wax esters in paraffin oil (No. 9) produced substantially better results than paraffin oil alone (No. 12).

TABLE 8. The same test on SAE 1018 steel produced these results. Carbon tetrachloride (No. 1) again shows very good results. However, compounded animal, vegetable and mineral waxes in halogenated hydrocarbon (No. 4) is about equal to carbon tetrachloride and refined wax esters in halogenated hydrocarbon (No. 6) and modified wax esters in halogenated hydrocarbon (No. 8) are somewhat better; however, modified wax ester in paraffin oil (No. 9) produced better results than refined wax ester in paraffin oil (No. 5). Proprietary wax blend *C* (No. 10) again shows good results and displays a progressive improvement with increased dilution in halogenated hydrocarbon.

TABLE 9. This is the first of three charts showing the summarized results of a series of turning tests conducted to compare tool force, tool life, surface finish and side wear. These cutting speed tool life tests were made on both SAE 1018 steel and type 304 stainless steel. A series of tool failures was obtained by varying the cutting speed and keeping all other factors constant.

Turning cuts were made for each fluid on each material. These were run in sequence along the length of each bar. A slow and fast cutting speed was used for each fluid. Speeds of 25 and 60 fpm were used for type 304 stainless steel, while 25 and 250 fpm were used on both the SAE 1018 steel and 2S aluminum. The depth of cut, feed rate, and tool shape remained constant throughout this series of tests. Fluids were applied to the shoulder of the work and the tool point. A Profilometer was used to give direct readings of surface roughness in microinches. One set of measurements was taken perpendicular to the feed marks while a second set was taken parallel to the feed marks. The readings show a wide discrepancy between parallel and perpendicular measurements; however, there is an obvious reason for this. Due to the shape of the tool and the feed used on these tests, the feed marks result in a notch-shaped pattern, giving high roughness values. When the roughness readings were taken parallel to the feed marks the diamond point traced along the bottom of a single valley, and the variations encountered were surface irregularities caused by the fluids. This method of measurement produces a much more accurate picture of the effect of cutting fluid, since the influence of feed and tool shape is practically nil.

These summaries were prepared by the University of Michigan Staff. TABLE 9 shows results on SAE 1018 steel. Commercial cutting fluid *A* and

TABLE 9 — Cutting Tool Life Tests — SAE 1018 Steel

Rating	Tool Force	Tool Life	Surface Finish	Side Wear
Best ▲	(1) Modied wax esters in paraffin oil	(1) Modified wax esters in paraffin oil	(3) Commercial cutting fluid A	(2) Commercial Cutting fluid A plus wax esters
	(2) Commercial Cutting fluid A plus wax	(4) Emulsified wax esters	(5) Mixture mineral & ester type wax in paraffin oil	(5) Mixture mineral & ester type wax in paraffin oil
	(3) Commercial cutting fluid A	(8) Commercial fluid B	(7) Soluble oil plus wax esters	(7) Soluble oil plus wax esters Dry
	(4) Emulsified wax esters	(6) Commercial soluble oil	(1) Modified wax esters in paraffin oil	(6) Commercial soluble oil
	(5) Mixture mineral & ester type waxes in paraffin oil	(7) Soluble oil plus wax esters	(4) Emulsified wax esters	(3) Commercial cutting fluid A
	(6) Commercial soluble oil	(2) Commercial cutting fluid A plus wax	(8) Commercial fluid B	
	(7) Soluble oil plus wax esters	(5) Mixture mineral & ester type wax in paraffin oil	(2) Commercial cutting fluid A & wax esters	
▼	(8) Commercial fluids B	(3) Commercial cutting fluid A	(6) Commercial soluble oil	
Worst	Dry	Dry	Dry	

Table 10—Cutting Tool Life Test—Type 304 Stainless Steel

Rating	Tool Force	Tool Life	Surface Finish
Best	(1) Commercial cutting fluid A	(7) Emulsified wax esters	(1) Commercial cutting fluid A
	(2) Commercial fluid B	(1) Commercial cutting fluid A	(6) Mixture mineral & ester type wax
	(3) Modified wax esters in paraffin oil	(1) Commercial cutting fluid A	(5) Soluble oil plus esters
	(4) Commercial soluble oil	(2) Commercial fluid B	(4) Commercial soluble oil
	(5) Soluble oil plus esters	(6) Mixture mineral and ester type wax in paraffin oil	(3) Modified wax esters in paraffin oil
	(6) Mixture mineral & ester type wax	(5) Soluble oil plus wax esters in paraffin oil	(7) Emulsified wax
	(7) Emulsified wax esters	(3) Modified wax esters in paraffin oil	(2) Commercial fluid B
	(8) Commercial cutting fluid A plus wax esters	(4) Commercial soluble oil	Dry
Worst	Dry	Dry	(8) Commercial cutting fluid A plus wax esters

commercial soluble oil were both tested with wax esters added as well as without wax esters, and commercial fluid *B*, a third commercial fluid, was also tested.

Modified wax esters in paraffin oil (No. 1) produced lowest tool forces and best tool life. Best finish was produced by cutting fluid *A* (No. 3) which also produced the poorest tool life. Least side wear was shown by commercial cutting fluid *A*, plus wax esters (No. 2).

TABLE 10. Shown are the results of the same tests on 304 stainless steel. Cutting fluid *A* (No. 1) showed lowest tool force values, very good tool life and best finish, but emulsified wax esters (No. 7) produced the best tool life of all fluids tested. Commercial fluid *B* (No. 2) shows an indefinite performance pattern, showing mediocre results in the all-important tool life column on both TABLES 9 and 10. Although these tests on stainless steel again did not demonstrate great difference between fluids, it is interesting that emulsions are at the top of the tool life column. Emulsified wax esters (No. 7) are excellent producers of tool life on both 1018 steel and 304 stainless, but modified wax esters in paraffin oil (No. 3), the best tool life performer on 1018 steel, is low in the tool life column on 304 stainless, demonstrating again that different metals place different demands on cutting fluids and that emulsions are not as acutely affected by these differences as are oil base fluids.

TABLE 11. This is a summary, similar to TABLES 9 and 10, of turning tests on 2S annealed aluminum showing only tool force and finish ratings. Cutting fluid *A* (No. 5) again produced the best finish but is rather low in the tool force column, but the same fluid, plus wax esters (No. 1), produced directly opposite results. The tool force column here is completely dominated by fluids containing wax esters and the finish column is nearly so. Two fluids produced poorer finish than dry cutting (Nos. 2 and 7).

From these data, many conclusions or, at least, indications can be drawn. It seems evident that tool life and finish do not necessarily have anything in common where cutting fluids are concerned. Indeed, even tool forces and tool life do not always go hand in hand. It is evident, also, that waxes do not qualify as ingredients merely by being waxes. Some were consistently excellent performers, and some were just as consistently poor. Obviously, the effectiveness of a wax material depends not only on the material itself, but also on the manner of compounding, (i. e., whether emulsion or solvent type), the type of dilutent and the extent of dilution. The effect of all of these factors has been demonstrated.

Other significant trends or patterns showed up. It seems evident that proper waxes improve other fluids, even including carbon tetrachloride. Probably most significant is the fact that water-dispersed fluids seem to tolerate the broadest range of conditions and seem to be more nearly the universal

Table 11—Turning Tests on 2S Annealed Aluminum

Rating	Tool Force	Surface Finish at 25 fpm
Best	(1) Commercial cutting fluid A plus wax esters	(5) Commercial cutting fluid A
	(2) Modified wax esters in paraffin oil	(4) Mixture mineral & ester type wax in paraffin oil
	(3) Emulsified wax esters	(6) Soluble oil plus wax esters
	(4) Mixture mineral & ester type wax in paraffin oil	(3) Emulsified wax esters
	(5) Commercial cutting fluid A	(1) Commercial cutting fluid A plus wax esters
	(6) Soluble oil plus wax esters	(8) Commercial fluid B
	(7) Commercial soluble oil	Dry
	(8) Commercial fluid B	(2) Modified wax esters in paraffin oil
Worst	Dry	(7) Commercial soluble oil

type of cutting fluid. Certainly emulsions produced a better tool life pattern than other fluids in these tests.

Tool force values follow a dependable pattern although inconclusive data were produced on some operations. For example, reaming 1018 steel showed one value as low as 65 percent and five results over 100 percent, one as high as 116 percent. Tapping 1018 steel shows prominent differences in cutting forces between spiral point and standard point taps, strangely enough always in favor of the standard point.

Although 304 stainless steel shows smaller force reductions, the results seem to be consistent and dependable, comparable to results on 1018 steel and aluminum, though less amplified.

Field Experience

In the field of drawing and forming, tube drawing is admittedly a severe metalworking function In terms of unit pressures, the yield point of the metal is exceeded and the lubricant used must withstand this extremely high pressure. Normally, the die and mandrel are lubricated by a continual flow of viscous extreme-presure fluid or, in some cases, the tubing is prepared with a phosphate etch and then lubricated.

A drying type of wax emulsion is being used to do this same job with some notable exceptions. No preparatory treatment is necessary, other than routine cleaning. As many as six substantial reductions can be made in the same tube with one application of wax on the order of 0.0005 inch thick. No relubrication is necessary, unless annealing interrupts the process. After the final draw the tubing is dry, clean, and fully bright and in many cases the remaining wax film can be left on for its protective value. Temperature and pressure resistance are dramatically demonstrated. The continued adhesion of this insignificantly thin film of lubricant, through repeated exposure to extremely high pressure, is surprising.

Table 12—Comparative Data for Wax Cutting Fluid and Sulphurized Oil

22 DAYS — 43 SHIFTS		
	Wax Cutting Fluid	Sulphurized Oil
Number of hours run:	324	325
Total no. of pieces produced:	59,771	59,762
Amount of fluid added:	None	15 gal
Tool Life — Times Each Tool Sharpened or Replaced		
Cut-off	0	3
Drill	55	63
Spot Drill	20	29
Slotting saws	3	6
Recess tool	3	6
Reamer	12	9
18 Days — 35 SHIFTS		
	Wax Cutting Fluid	Sulphurized Oil
Number of hours run:	256	256
Total no. of pieces produced	49,685	51,316
Amount of fluid added:	None	15 gal
Tool Life — Times Each Tool Sharpened or Replaced		
Cut-off	0	3
Drill	45	46
Spot drill	15	22
Slotting saws	0	4
Recess drill	0	5
Reamer	8	7

The following record of a cutting fluid test under production conditions gives an indication of what wax can do in cutting. The purpose of the test was to secure comparative values for a wax-in-paraffin oil fluid and sulphurized oil. The machine used was a 6-spindle Greenlee automatic, one-inch capacity. The material was 0.3437 inch diameter, No. B-1113 steel. The sulphurized oil used was a well-known commercial fluid. Each fluid was run for one month. A report form was filled out at the end of each 8-hour shift for the full two-month period. Each month one shift was lost through shutdown or sickness, thus each month shows 22 working days, but only 43 shifts.

TABLE 12 shows a summary of the 43 reports filled out for each fluid.

The chart *A* at the top shows the results of the full 22 working days of each month. It is interesting that the number of pieces produced with the two fluids is almost identical, even though tool life was substantially better with the wax cutting fluid, remarkably better on some tools. With better tool life and consequently less down time, it should certainly be expected to produce more pieces, and more production was surely available.

No wax cutting fluid was added in 22 days, whereas 15 gallons of sulphurized oil were required.

The chart at the bottom of TABLE 12 is a breakdown of the final 18 days of each month. Under wax cutting fluid, it can be seen the slotting saws and recess tool were sharpened or replaced three times on the 22 day record, but were not serviced at all in the last 18 days. Thus, these tools required sharpening or replacement 3 times in 4 days, which must have seemed excessive, but went the last 18 days without further attention. The reamer was replaced 12 times in 22 days, but only 8 times in the last 18 days. Thus, ⅓ of the reamers were used in 4 days, after which reamer life was about equal for the two fluids. It is interesting to see that this test bears out the findings in the University of Michigan tests that drilling and reaming do not respond as well to fluids as do other operations. However, the overall record must be considered conclusively in favor of wax.

Summary

First, wax is not a replacement for chemically active extreme-pressure ingredients in cutting fluids. It is not a replacement for pigments or other inorganic solids in drawing lubricants. It does, however, enhance the value of both these materials. The right wax is a lubricator, a reducer of friction, with exceptional properties in the fields of temperature, pressure and adhesiveness. It is not a panacea. It is not a film strength material. It is a fluid film lubricant. It is difficult to include wax, a solid material, in fluids for cutting and forming metal without developing some objectionable behavior pattern, but it has been done. Selection of the right ingredients is only half the job. The other half lies in determination of the proper vehicle, development of the correct process and exact control of that process.

Fig. 1. Feeder for machine screws. The reciprocating blade hopper is converted to feed other blanks by changing the blade, ejector, and front and back spacers.

Automatic Sorting, Feeding and Injecting Devices*

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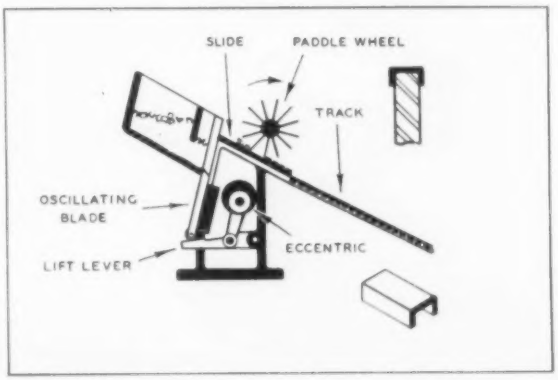
HOPPER FEEDS which automatically select and deliver parts to machines for processing have grown in importance in metalworking and allied fields. Because of soaring costs, any tool which promises increased and more automatic production is accepted eagerly. Failure to fully realize expected production gains from the use of sorters and feeders has sometimes resulted from insufficient understanding of correct principles of hopper design and application.

When considering automatic feeding a particular part, the engineer must choose a hopper type which will provide an adequate delivery rate, ample capacity, long life, and low maintenance cost.

A part must meet certain requirements to be suited to hopper feeding. The ideal blank has simple lines. It is fairly small and will not interlock when grouped with other like parts. Headed blanks such as screws, bolts, and rivets present few problems. Round parts such as washers, dowels and disks are easily handled. Often a slight modification in a part will allow it to be sorted and fed with ease in a comparatively low-cost hopper.

Special considerations, such as fragility of parts, must not be overlooked. Also, care must be taken to ascertain how a part will behave in bulk. A hopper which will feed free rolling parts might be entirely unsuited to handling parts that tend to

Fig. 2. Lift hopper represents a beginning development in the field—the basis of current refinements, as in the blade hopper above.



*Abstracted from paper 21T5, "Principles of Automatic Sorting and Feeding," presented at the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society Headquarters.

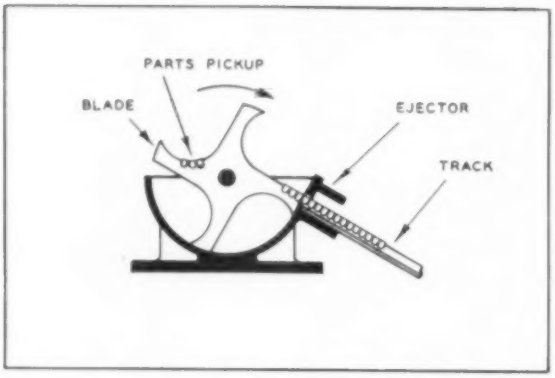
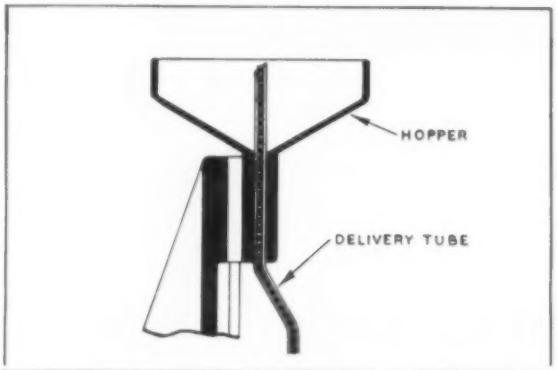


Fig. 3. (Above) Rotating blade hopper, lift type.

Fig. 4. (Below) Tube hopper is inexpensive and has a high delivery rate, low maintenance costs. However, it is limited to simple parts.



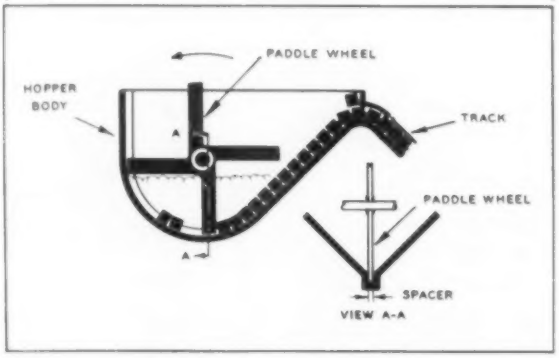
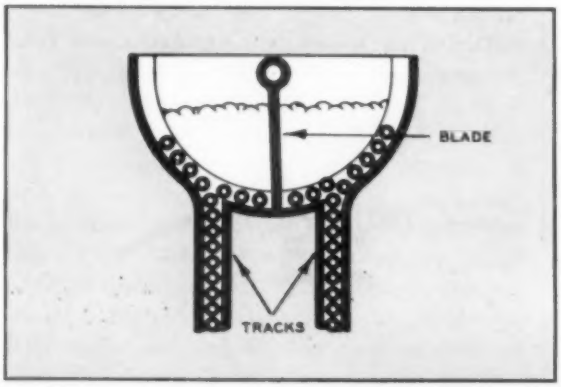


Fig. 5. (Above) Feeder is typical of paddle-wheel types. The slot and hopper shape orient the blanks.

Fig. 6. (Below) As with tube hoppers, paddle-wheel feeders are limited to simple parts.



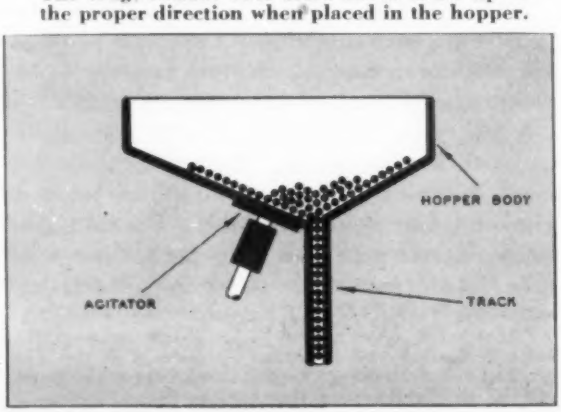
interlock in a mass, for example, open-coil compression springs.

Bolt and screw manufactures were early pioneers in developing hopper feeds, and naturally hoppers have been most widely employed in this field. In some shops, hand feeding is virtually unknown; all blanks for bolts, screws, and nuts are fed automatically to machines for chamfering, threading, and slotting operations. Some typical applications will be discussed in the following paragraphs.

Lift Hoppers: Illustrated in *Fig.* 1 is a present-day reciprocating blade hopper. The blade travels up and down through the parts, picking up some blanks in its upward travel. At the top of its stroke the blade comes in line with the front spacer and the parts slide down to feed the machine along the stationary track. When the blade goes down for more parts an ejector advances to the end of the front spacer, gently pushing incorrectly positioned parts back into the hopper. An opening, machined in the toe of this ejector, allows only correctly positioned blanks to pass through to the machine, making it impossible for the hopper to jam. The hopper, self-powered by a gearmotor, is simply mounted on a bracket on the machine. Wiring is run to the gearmotor so that the hopper feed begins operating when the machine is started.

An early design of lift hopper is shown in *Fig.* 2, in which an oscillating blade is driven by an eccentric and lever. In its upward travel it raises a few parts to the level of the slide. These pass down until they reach the vanes of the paddle wheel. The vanes are machined to closely fit the outside contours of the part being fed. Consequently, blanks which are correctly positioned pass through the vane openings to the track. Parts not correctly positioned are prevented from going through; they either tumble about until they become correctly aligned or fall back into the hopper. The view at the upper right shows a section through the track with a typical blank in feeding position. Another view of

Fig. 7. This rod feeder utilizes a reciprocating agitator to keep the track filled with parts. The long, slender rods must all be lined up in the proper direction when placed in the hopper.



this blank is shown at the lower right corner.

Containing many refinements of the lift principle, the hopper shown in *Fig.* 3 has a scimitar-shaped blade of correct thickness and form to suit the blank. It is indexed intermittently in the direction shown. Parts are picked up at the bottom of the hopper and, as the blade indexes to a position opposite the track, they slide to the feed. The ejector has an oscillating movement parallel with the track to clear away possible jams.

The irregular shape of the blade makes this a rather expensive feeder to manufacture and it is not entirely foolproof against jamming.

Oscillatory Tube Hoppers: *Fig.* 4 illustrates the commonly used tube hopper, one of the oldest types. It feeds simple parts—short rods or short lengths of tubing. With a delivery tube of rectangular section, it may be used to feed round disks such as plain button blanks or regular washers. The upper end of the delivery tube is machined at an angle to prevent possible jams when improperly positioned parts try to enter. Its lower end is fastened to the feeding mechanism of the machine. The hopper is funnel shaped and oscillates vertically to keep the tube filled with parts.

Whenever tubing is used to conduct parts, as in this instance, it should be stainless steel. Condensation causes rust and eventual sticking of parts in regular steel tubing. Elongated slots machined lengthwise in the tube at exposed places provide access to oversize parts which might clog the feed.

Paddle Wheel Types: The paddle wheel type of hopper illustrated in *Fig.* 5 is widely employed in feeding square or hexagonal nut blanks. The body is generally cast in two halves, separated by a spacer slightly greater in width than the thickness of the part to be fed as shown in the cross section. The paddle wheel rotates in the direction of the arrow, agitating the blanks, causing properly positioned ones to drop in the slot in the bottom of the hopper. The blades of the paddle wheel push these parts up the inclined portion of the hopper. At the top they enter the track and slide down to the machine by gravity. When the track is full, subsequent blanks ride up and drop back into the hopper.

Similar in operating principle, the hopper shown in *Fig.* 6 utilizes a single blade to agitate and move the blanks. The blade oscillates in pendulum fashion, causing properly positioned blanks to enter the slot in the bottom of the hopper. Moved by the blade, the blanks drop in the two tracks. This hopper can supply a machine which operates on two blanks simultaneously, or it can feed two separate machines.

Rod Feeder: Long, comparatively slender rods are fed automatically by means of hoppers of the type shown in *Fig.* 7. This consists of a hopper body at the bottom of which is fastened a track. The agitator reciprocates and serves to clear the track opening of jams. This type of feed renders necessary the pre-positioning of the blanks in one direction. In most cases it would be impractical to build a hopper to select long rods from bulk because such a hopper would be of excessively large size.

This type of feeder is one of the few which readily lends itself to welded construction. Most hopper bodies are of such irregular form that they are either cast of iron or cast aluminum. Meehanite offers promise in the construction of hoppers for feeding hardened parts. These parts have considerable abrading action on some hopper walls, with resultant shortening of the useful life of the unit. Cast aluminum bodies, in conjunction with stainless steel hopper parts, are indicated in the processing of edible products such as candy wafers, pills and medicinal capsules fed to packaging machines.

Tumble Hoppers: Tumble hoppers are a valuable class of feeders, particularly in cases where

Fig. 8. A rotating-drum hopper of the tumble type. Useful in feeding parts which are difficult to separate in bulk. This hopper is arranged for feeding nails.

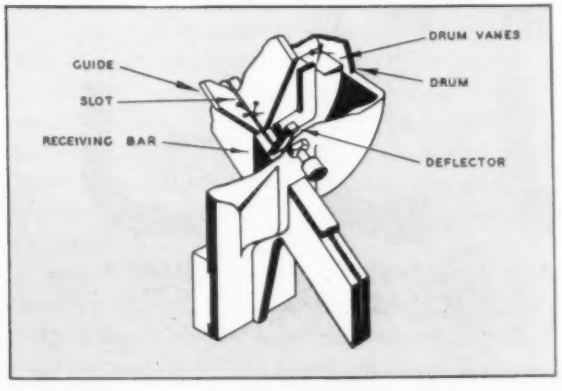
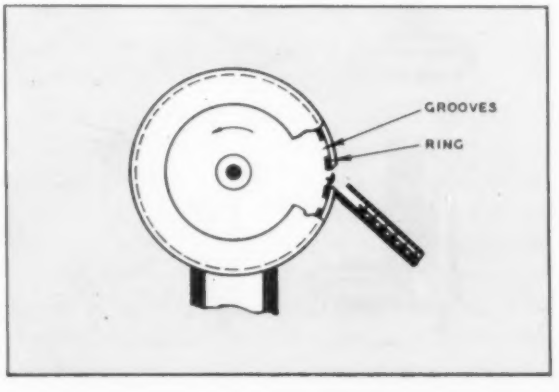


Fig. 9. The rotary hopper makes use of a revolving ring with specially shaped grooves to sort out individual pieces and carry them to the feed track. Excess parts tumble back.



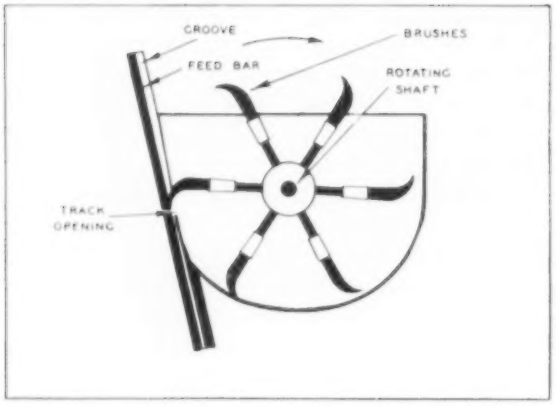


Fig. 10. Brush hoppers have limited application because of excessive maintenance.

workpieces have a tendency to interlock and mass. *Fig.* 8 illustrates the fundamental construction of these hoppers. A drum with vanes either cast integrally with, or fastened to the inside surface, rotates constantly. Vanes shaped to pick up and to a certain extent pre-orient the blanks, carry the blanks upward until they drop into the guide which leads them into the slot machined in the receiving bar. To this bar is fastened a track which delivers the blanks to the machine.

A suitable deflector causes improperly positioned parts to fall back into the hopper. In *Fig.* 8, the feeder is shown arranged so as to feed nails to a nailing machine.

When designing hoppers with rotating parts, careful attention should be given to the bearings. They must be shielded so there is no possibility of contamination of the blanks by the lubricant employed. Sealed ball bearings have been very successful in many applications. Porous bronze bearings with an adequate oil reservoir will give excellent service at many hopper wear points.

Rotary Hoppers: Rotary hoppers form a large and indispensable class of feeders, consisting essentially of a hopper body of circular construction within which a ring is rotated, either constantly or intermittently. *Fig.* 9 illustrates one type of rotary hopper arranged to feed special buttons to a machine for further processing. Grooves machined in the rotating ring are so shaped as to width and depth that only properly positioned buttons are admitted and carried up to the delivery point; the others tumble back to the bottom of the hopper. At the delivery point the parts turn over and enter the track in proper position for the subsequent process.

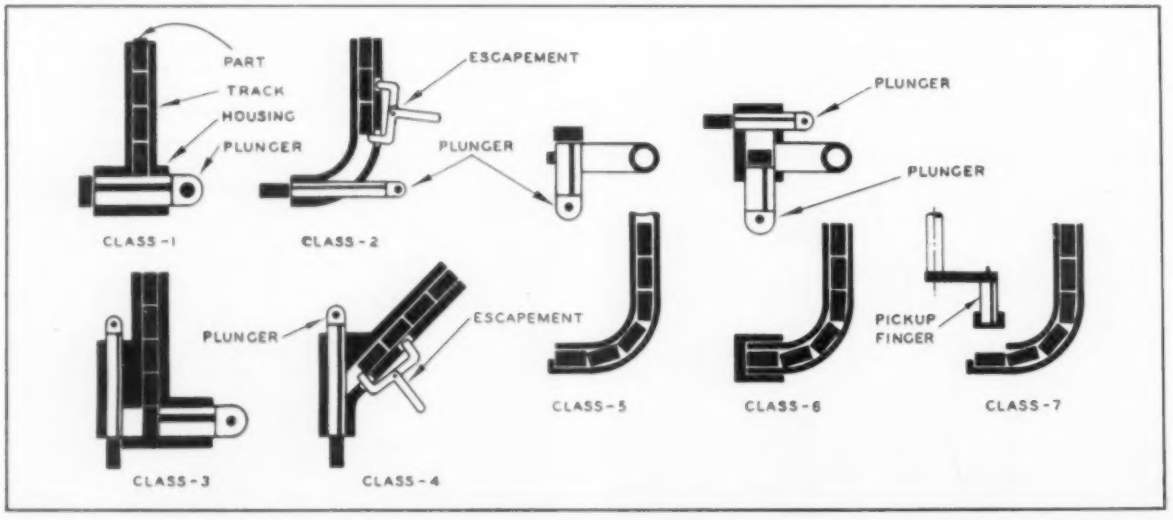
Rotary feeds turn at slow speeds when designed for continuous operations. Twenty revolutions per minute is considered the fastest practical speed, with ten revolutions per minute more common.

Brush Hoppers: Numerous hoppers have been built using brushes to agitate and feed parts. Most of these have not been entirely successful because maintenance costs are apt to be high. However, the hopper shown in *Fig.* 10 has been entirely satisfactory for feeding light parts such as metal clasps for manila envelopes. The groove machined in the feed bar is shaped to receive parts which happen to fall correctly positioned.

Brushes mounted on a rotating shaft deliver a continuous supply of parts to the track opening and also clear the track opening of possible jams. The brushes raise parts from the bottom of the hopper, and allow them to fall in a more or less steady stream to the track opening. Those which drop in the proper position enter the track and proceed to the machine as required.

This hopper design leaves much to be desired; rapid brush wear will result in speedy malfunction-

Fig. 11. Typical injector mechanisms for inserting parts into a processing machine from the feeder track. These devices illustrate solutions to various position requirements.



ing, and capacity is low. However, it does successfully feed a part which is extremely difficult to handle automatically.

Feeding the Blank into the Machine

After an automatic feeder has been designed to keep a track full of parts for delivery to a machine, methods must be devised by which blanks at the bottom of the track or tube can be properly injected or fed into the machine.

The design of the injector mechanism will depend to a great extent upon the shape of the part being fed. *Fig.* 11 shows, schematically, a number of possible track and injector arrangements for feeding a representative part. Class 1 is the simplest arrangement, one which should be used whenever practical. The track is fastened to the housing of the injector mechanism. Within this housing a simple plunger, moving in timed relationship with other parts of the machine, transfers the part from its bottom position in the stack and inserts it into the machine. In assembly machines, the receiver is often a dial carrier which brings the blank to assembly position.

In Class 2, the part is to be inserted into the machine in a horizontal position. This is accomplished by means of a 90-degree bend in the track, an escapement and a plunger. The escapement allows one part at a time to slide down into feeding position. The plunger then advances, injecting the part into the machine while the escapement assumes the position shown, with the column of parts dropping against the lower toe, ready to allow the lowest blank to drop when the plunger is retracted.

In Class 3, the part is required to be fed downward in a vertical position. This is simply and positively done by means of two plungers as shown. These are linked together so one is retracted as the other advances. An identical part feeding requirement is Class 4, where feeding is done by means of a vertical plunger and an escapement to allow only one blank at a time to go through.

In Class 5, the part is fed in a horizontal position to the machine by means of a plunger and a 90-degree track. The Class 6 mechanism delivers a part in the same position as that shown in Class 2. However, instead of making use of the rather delicate escapement, two husky plungers feed the part, making for a better design.

The Class 7 mechanism makes use of pickup finger which descends and grips the blank between spring loaded jaws. It then swings around and deposits the part in a nest in the machine.

When feeding more complicated workpieces, the injector mechanism often requires careful engineering to assure trouble-free operation. In some instances, where the hopper cannot completely orient the workpiece, the injector mechanism is required to give it its final position. However, in most cases, the mechanism which inserts the blank into the machine will follow one of the principles previously illustrated. A thorough knowledge of techniques used to handle simple parts will help when dealing with more complicated ones.

Reactor Control Provides Constant Cutting Speed

Maintaining a constant speed while cutting is one of the prime requirements of the metal-cutting operation. Also, in machining any metal there is one best cutting speed. A higher speed damages the tool; a lower one cuts production. To machine the face of a jet-engine disk, the disk is rotated and the tool is moved radially across it. To maintain constant cutting speed the rate of feed of the tool must change as the tool moves toward or from the center. Mostly a mechanical linkage to a rheostat in the motor field circuit has been used to approximate the desired speed control. But this has been clumsy, generally unsatisfactory.

A control employing a small reactor supplies a solution to the problem. To control the machining of a given piece, a simple, small cam is cut. A probe from the reactor, which is contained in a box about four inches cube, rides on this cam as the cutting progresses. As the probe moves up or down—a total distance of only nine-sixteenth inch—it moves an armature that changes the reluctance of the reactor magnetic circuit. Through an electronic exciter this varies the motor field strength to change the d-c motor speed to hold the cutting speed constant.

The motor has an eight-to-one speed range, obtained solely by control of motor field strength. This speed range is double the amount ordinarily available by field control and is made possible by two sets of windings on each of the four poles. These are automatically connected in different sequences to obtain net flux changes much larger than normal. The system avoids mechanical linkages, is stepless, and involves no sliding contacts or rotating bearings.

Fig. 1. Outer skin, flooring, bulkheads and outriggers of this blimp control car are all of aluminum-balsa sandwich (metal-bonded) construction.

METAL BONDING*
A Report on Current Practices

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ALTHOUGH THE ADHESIVE BONDING of metals is a slow process compared to joining methods such as flash welding and multiple spot welding, it has nevertheless made a definite place for itself in industry. It has proved especially adaptable to aircraft structures such as the blimp control car, *Fig.* 1.

The essential elements in all adhesive bonding of metals are cleaning, the application of adhesive, pressure, heat and time. Cleaning may be accomplished by vapor degreasing, alkaline cleaning, solvent wash, anodizing or metal etching. Regardless of the methods used, a chemically clean surface is essential. The cleanliness requirement is similar to, but more critical than, that required for good paint adhesion. The cleanliness of the surface may be checked by observing a water-break film or by an electrical resistance check, depending upon the cleaning method used.

The adhesive may be applied by spraying, roller-coating, dipping, or brushing. Adhesive tape films placed between the surfaces to be joined may also be used, as described later. After the application of adhesive it is usually necessary to drive off the solvents, if present, to prevent the formation of blisters. The adhesive may be dried by exposing it to the atmosphere, by forcing hot air over it or by using infrared light. The length of time and the temperature of the drying period depend upon the method selected and the solvent vehicle used.

Heat and pressure applied simultaneously cure the bond. For the stronger adhesives the pressure required is usually 100 to 300 psi; the temperature varies from 275 to 350 F. Curing time varies with adhesives and temperature but is usually about 15 to 30 minutes. The pressure and temperature required may be supplied by steam or electrically heated presses or jigs and steam or hot-air autoclaves. Mechanical clamps and jigs may be used

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in conjunction with hot-air ovens, infrared lamps or heating blankets.

In recent years a series of new adhesives known as *Epoxies* have been developed. They can be cured at much lower temperatures and pressures. Known also as *Epons*, the ones most commonly used are almost 100 percent solids, eliminating the need for drying prior to curing. Curing temperatures for these adhesives vary from 70 to 200 F depending upon the chemical formula and the time in which the cure must be completed. With these adhesives pressure may be reduced to that needed for contact. Vacuum pressure and infrared lights are adequate for curing. The Epoxies are still in the developmental stage. Those now readily available for low-temperature curing applications lack the temperature resistance of current structural adhesives. New Epoxies with increased temperature resistance are expected.

Table 1—Properties of Typical Metal-Bonding Adhesives

Manufacturer	Code Number	Type of Adhesive	Shear Strength (psi)	Characteristics	Applications
Bloomingdale Rubber Company, Chester, Pa.	FM-47	Polymer-resin	4500	Thermo-setting Cure 275-350F	Metal to metal Aluminum to balsa wood Aluminum to honeycomb Aluminum to plywood
Bloomingdale Rubber Company, Chester, Pa.	PA-101	Elastomer-phenolic	3800	Thermo-setting 2-part adhesive Cure 200-300F	Metal to metal
Shell Chemical Corporation, San Francisco, Calif.	VI	Epoxy	3000	2-part adhesive Cure 70-200F	Metal to metal Aluminum to honeycomb Metal to glass Structural attachment insert Sandwich panel-edge filler
Cycleweld Cement Products, Trenton, Mich.	C-14	Epoxy	3000	2-part adhesive Cure 70-160F	Metal to metal Aluminum to honeycomb Metal to glass Structural attachment insert Sandwich panel-edge filler
Cycleweld Cement Products, Trenton, Mich.	C-3	Elastomer-resin	3500	Thermo-setting Cure 300-325F	Metal to metal Metal to wood

Processing Problems: A number of processing problems peculiar to structural bonding are: cleaning, excessive humidity, thermal distortion, and tooling. The necessity for thorough cleaning has already been discussed. Once cleaned, the metal must be kept clean until the adhesive has been applied. Unnecessary handling must be eliminated and clean gloves should be worn whenever the metal is touched. The adhesive should be applied promptly after cleaning to avoid contamination of the metal surface.

Extreme atmospheric humidity is a problem with many adhesives due to the fact that, when they are applied, evaporation of the solvent cools the metal surface. This causes condensation of moisture between the adhesive layer and the metal, resulting in an inferior bond. This condition is termed poor wetting. It can be prevented by applying the adhesive in an air-conditioned room. However, where large amounts of adhesive are being applied, as in spray booths, the volume of ventilating air needed may be so great that air conditioning is not feasible from a cost standpoint. The moisture problem may be minimized by the use of less volatile solvents. It is necessary to avoid applying some adhesives when the relative humidity exceeds 40 percent. Poor wetting may not be apparent at the time of processing but, with some types of adhesives, can be detected by the peel-test method described later.

Another production problem involves thermal conditions present during curing. Thermal warpage may occur when materials of different thermal coefficients of expansion are bonded. This condition can be minimized by using adhesives with lower curing temperatures or by designing the assembly to allow thermal stresses to be relieved without producing undesirable warp. For these reasons it is desirable to use materials of similar thermal expansion coefficients in the tooling and in the assembly.

At present the acceptability of an adhesive bond, like the acceptability of a spot weld, cannot be fully evaluated without destroying the assembly. The best way to insure a high-quality product is by means of rigid process control. Many attempts have been made to develop nondestructive testing methods but none has proven satisfactory. Voids

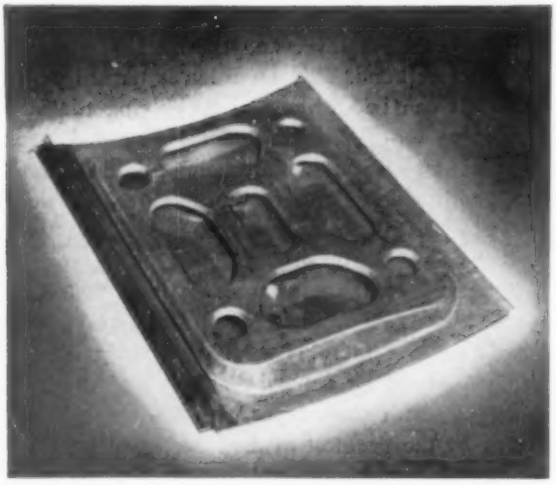


Fig. 2. Metal-to-metal bond of access door and stiffener eliminates rivets.

or no-bond areas may be discovered easily by tapping with a coin or other similar instrument, but so far there is no sure method of finding poorly bonded areas.

Physical Properties of Adhesives: Various types of structural adhesives develop shear strengths between 3000 and 4500 psi, TABLE 1. The fatigue strength is usually better than that of other joining methods such as riveting and spot welding. Most adhesives are highly resistant to chemicals and weathering attack. Perhaps their most vulnerable characteristic, compared with other joining methods, is a somewhat lower resistance to peeling action. This handicap is easily overcome by proper design.

Uses of High-Strength Adhesives: High-strength metal adhesives have been used in the aircraft industry to attach stiffeners, ribs, doublers, and accessories. *Fig.* 2 shows an example of the attachment of stiffeners by this method. The British have used metal-bonding adhesives to replace rivets in conventional aircraft structures. They report a considerable weight saving. Airfoil skins of variable thickness may be manufactured by bonding one or more doublers of suitable contour to them. This method represents a substantial cost saving over machining such a plate from a thick sheet.

The fact that metal-bonding adhesives are capable of joining dissimilar materials leads to many useful applications. In the automotive industry brake-lining and clutch-facing materials are frequently bonded to their steel backing plates. This provides an improvement over riveting which results in uneven wear and scoring of brake drums and clutch faces. In a test a steel bolt was bonded to a piece of glass. When a tensile load was applied to the bolt, the glass failed first, demonstrating that the bond was stronger than the glass. Such bonding could be used to attach glass shelving to supporting structures. Electrical conducting materials could be bonded to non-conductors or metals could be bonded to glass or china to produce art creations.

Sandwich Materials: One very important use of the ability of metal-bonding adhesives to join dissimilar materials is found in the manufacture of sandwich materials. A sandwich material consists of a lightweight core material with metal skins adhesively bonded to two opposite faces.

Sandwich structures are stiffer and more resistant to bending and edgewise compression than a solid metal sheet of the same weight. The resistance of such a material to wrinkling caused by shearing and other types of stresses results in increasing the rigidity of the structures in which it is used.

Lightweight core materials are frequently lacking in resistance to compression. As a result it is

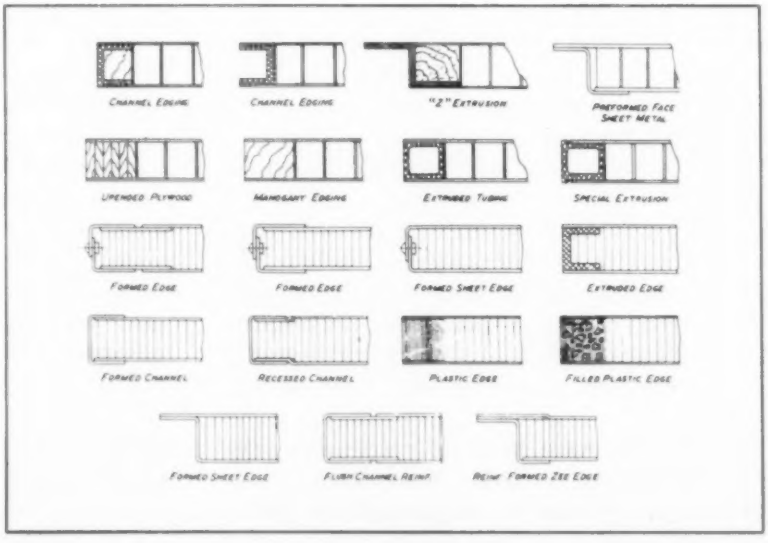


Fig. 3. Design details of a variety of reinforcements used to overcome compression weakness of sandwich core.

Table 2—Typical Heat Transfer Coefficients of Sandwich Panels

Type Core	Density (lb/ft³)	K (Btu/hr/ft²/°F/in.)
Foam	10.0	0.2
Aluminum honeycomb	4.3	13.0
Balsa	8.3	0.36

often necessary to build reinforcements into the sandwich at points where the load exceeds the values which the core material can resist. Such reinforcements may be suitably shaped pieces of wood. Mahogany is frequently used for the purpose. Plastics and metal extrusions have also been used as pictured in *Fig.* 3.

Sandwich Core Materials: One of the first sandwich-core materials used was balsa wood with the grain running lengthwise. It was soon discovered that balsa had very little resistance to tension and compression across the grain as compared to considerable resistance to these farces parallel to the grain. For this reason balsa sandwich panels manufactured today use balsa with the grain normal to the metal faces.

Since balsa wood is an organic material, its range of physical properties is limited and subject to considerable variation. Many attempts have been made to produce core materials with a greater variety of more closely controllable physical properties. One scheme tried for manufacturing core material was to stack soda straws or thin metal tubes coated with adhesive with their axes parallel and cure them with suitable heat and pressure. After curing they were sliced as previously described for balsa core. Another method was to print parallel glue lines on paper or metal sheets, stack and cure them in a press and expand them in a manner similar to the familiar paper Christmass bells.[1*] Impregnated paper, cloth and metal have been corrugated, coated with glue, stacked, and cured with heat and pressure to produce this type of core. Cellular magnesium, hard-rubber foam, cellular plastics and plywood have also been used.

Another very useful core material is known as foamed-in-place plastic core.[2] This material is advantageous for certain applications since before curing it is a liquid which can be poured into the cavity between irregularly shaped and spaced plates. After curing it becomes a cellular material. Foaming materials are available which will adhere to a variety of face-plate materials. Foaming is accomplished by use of chemicals which produce a gas. These materials are available in a variety of properties as follows: Density from 4 to 20 pounds per cu ft; shear, 80 to 700 psi; tensile strength, 100 to 500 psi; and compression, 10 to 700 psi depending upon the ambient temperature and whether core material is parallel to or at right angles to the grain[3].

Sandwich Processing: In the manufacture of sandwich materials the face skins are cleaned and adhesive applied as previously described for bonding metal to metal. The core material is brought to its final thickness by sawing, sanding, milling, or other suitable means. The core thickness tolerance for panels of constant thickness is plus or minus 0.005 inch. Irregular shapes may be obtained by milling or sanding. Contoured shapes may be obtained by milling or contour sawing, using special equipment. In the fabrication of constant-section sandwich panels with compound curvature, it is possible to form some of the core materials without the use of expensive equipment. Although balsa wood will not form to a sharp radius, small segments of core may be used in order to arrive at the finished contour. Sections of core material can also be tapered or routed by grinders, machine tools, saws, or sanders. It is usually unnecessary to clean the core prior to application of the adhesive because the cutting operation results in a surface clean enough for bonding. The processing methods are similar to those used in plain metal-to-metal bonding. Flat panels are usually cured in a heated press. Curved panels may be cured by covering the assembly with a close-fitting air-tight blanket sealed around the edges and evacuated. Heat from infrared lamps or an oven is sufficient for the curing process.

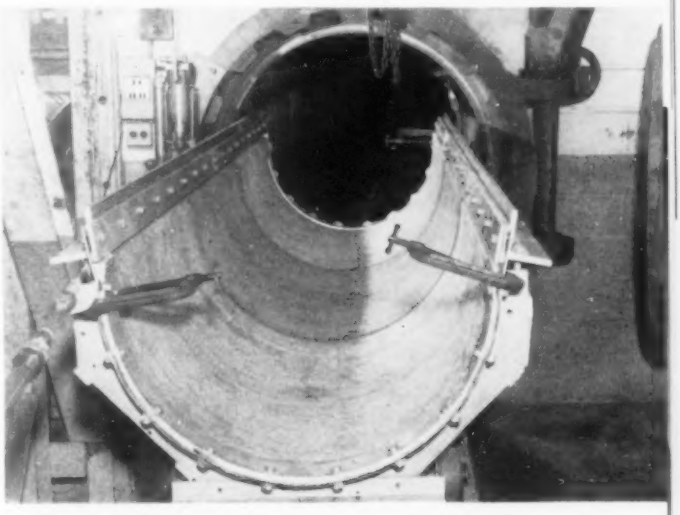


Fig. 4. To bond a large, curved panel of aluminum-balsa an autoclave is used to provide the required pressure.

Balsa sandwich requires grater pressure than honeycomb because of the relatively continuous nature of the surface of the core. Curing is accom-

* Numbers refer to references listed at the end of the article.

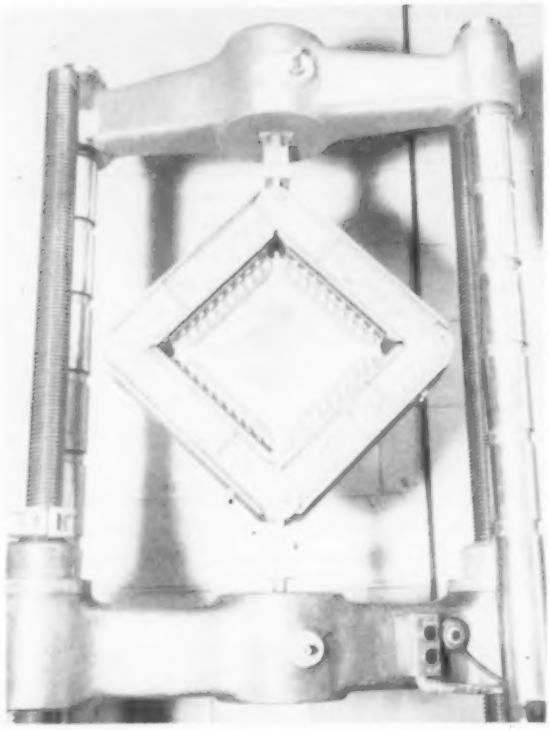


Fig. 5. Bonded sandwich material undergoing picture-frame shear test.

plished the same as for honeycomb except that an autoclave must be used for curved panels to obtain sufficient pressure. *Fig.* 4 shows an assembly being placed in an autoclave.

One of the most recent developments in honeycomb sandwich fabrication is the use of adhesive film or tape. This film consists of an open-weave Fiberglass carrier coated with adhesive. In fabrication the adhesive film is interposed between the metal face and core material which has previously been primed with the liquid adhesive. The advantages of the use of the film adhesive are uniformity of glue line, increased toughness of bond, and greater resistance to impact and fatigue. Higher ultimate strengths can be developed in the face skin by using the larger cell honeycombs. The film increases the glue line weight by approximately 0.015 pounds per square foot.

Thermal problems encountered in the manufacture of sandwich panels are more severe than in metal-to-metal bonding because the resulting product is very stiff. The thermal problems are increased if wood edging is used because of the large difference in the thermal coefficientts of expansion of wood and metal. Mahogany is preferred where wood edging is required because its relatively high transverse tensile strength resists splitting.

As in metal-to-metal bonding, strict process control is essential to a quality product. Inspection is accomplished by tapping the finished assembly to locate void areas and by visual observation of the edges of the panel. It is standard procedure to periodically test a finished assembly to destruction to ascertain if good workmanship practices are being followed. Test samples are run in the production line with production articles as a general check on the adhesive, cleaning, temperature, time, and pressure of the process.

Properties of Sandwich: The design of sandwich structure is analogous to the design of I-beams. The high-strength material spaced to produce maximum bending strength and stiffness is like the flanges of the I-beam, while the core functions as a web and stabilizes the skin. Most design problems can be satisfactorily solved by conventional methods if the core is neglected in computing the moment of inertia of the sandwich.

The Air Force, the Navy and the Deptartment of Commerce have pooled their efforts in an attempt to standardize design criteria for sandwich construction in the aircraft industry. They have issued a publication[2] containing much valuable information regarding all phases of sandwich construction. It includes excellent bibliographies.

Typical strength values of sandwich materials composed of 24S-T Alclad skins and 4.3 pound per cu ft aluminum honeycomb core material are as follows:

1. Short-column compression	60,000 psi
2. Compression stress in face by flexural bending	55,000 psi
3. Shear in core material	230 psi
4. Picture-frame shear	35,000 psi

The following are some typical strength values of sandwich materials composed of 24S-T Alclad skins and 8 pound per cu ft balsa-wood core material:

1. Short-column compression	60,000 psi
2. Compression stress in face by flexural bending	55,000 psi
3. Shear in core	275 psi
4. Tension (parallel to grain)	800—1500 psi

In aircraft construction a certain amount of resistance to high temperatures is desirable and, in fact, is required by government specifications for the adhesives which are approved for use. An effort is being made to utilize sandwich materials where still greater temperature resistance is required. At present the limiting factor is the adhesive available. The Air Force has awarded a number of development contracts aimed at solving this problem. Sandwich construction can provide almost any degree of heat insulation required. Usually it is necessary to accept a compromise between heat insulation properties and the strength properties desired. TABLE 2 gives typical heat-transfer values for some of the commonly used sandwich materials.

Sandwich panels also offer advantages where

sound insulation is required but they are of little use in sound absorption because the smooth faces are good reflectors.

Plain aluminum honeycomb core sandwich panels of aircraft quality cost about 85 per sq ft. If the sandwich is curved with complicated edging, and inserts it will cost considerably more. This relatively high cost is due to aircraft requirements for extremely high quality combined with very low weight. Much lower priced sandwich materials can be designed for less exacting applications.

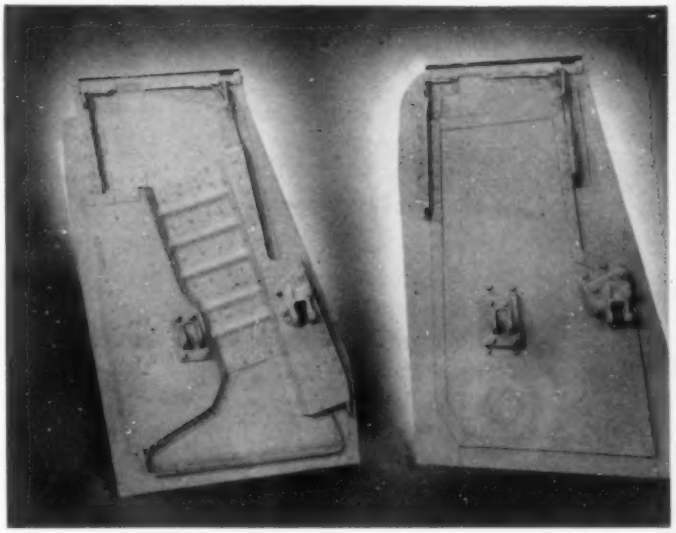
Sandwich Testing Methods: Pending availability of standardized testing procedures, members of the aircraft industry have developed their own tests for determining design criteria and for quality control. The following testing methods are typical of those used:

1. Shear strength of the core material is determined by testing sandwich materials as a simple beam with a five-inch span and center-point loading.
2. The allowable compressive stresses in the face skins is determined by testing a sandwich specimen as a beam with a 16-inch span. Two-point loading is used and the location of the loading points is adjusted for different core materials to avoid shear failure of the core.
3. The critical buckling stress of the face sheets are determined by testing sandwich material as a short column and by use of a picture-frame shear test, *Fig.* 5.
4. The fatigue limit of sandwich materials is determined by use of cantilever beam specimens with the oscillating load applied to the extreme end. (In sandwich construction the fatigue strength of core material is usually the limiting factor.)
5. The creep rate is determined by applying a constant center-point load to a sandwich beam for a long time. Time and deflection readings are taken. The creep rate is expressed in inches per hour. (The creep resistance of sandwich materials is largely determined by the type of adhesive used. Rubber-base adhesives have greater creep rates than resin base adhesives.)
6. Peel tests are used for quality control. Two methods of peel testing are used in the industry. One test consists of attaching one skin of the sandwich panel specimen to a cylinder and revolving the cylinder to peel the skin from the core. The average torque is a measure of the peel strength. In the second method a load is applied perpendicular to the face of the sandwich and the average force required to peel the face from the core is taken as the peel strength.
7. The soil-burial test is used to determine the resistance of various sandwich components and adhesives to moisture and microorganisms. This test is conducted by placing the test specimens in a highly organic soil which is maintained at a temperature of approximately 95 F and a moisture content of 25 to 30 percent by weight. The specimens are subjected to the above conditions for a long time, possibly one year. Specimens are removed at shorter intervals to determine deterioration.

Uses of Sandwich Materials: Some of the uses for sandwich materials are the following:

1. The designers of radar equipment are finding the smooth accurate surface provided by sandwich materials attractive for reflectors.
2. Lightweight durable handling trays made of sandwich materials have been used in a rubber shop to reduce the worker's fatigue and increase production.
3. On the left in *Fig.* 6 is a conventional airplane landing-gear door and on the right the sandwich structure door which replaces it. It will be noted that the sandwich door has a cleaner design since it does not require as many stiffeners. The edging is made of sheet metal and bonded to the assembly. The core was reinforced to permit attaching the fittings by means of bolts.
4. Flooring made of sandwich materials is rapidly replacing plywood for aircraft uses.
5. *Fig.* 7 shows the leading edge for a small amphibian airplane wing. This assembly is constructed entirely of aluminum alloy honeycomb sandwich.
6. A large aircraft fuel-cell door was built completely of aluminum alloy honeycomb sandwich.
7. *Fig.* 1 shows the control car of an airship largely of metal-bonded construction. Even the curved sections were all built of balsa sandwich with aluminum alloy faces. The fact that sandwich is used for primary load-carrying members is indicative of the reliability of modern metal-bonding adhesives.

Fig. 6. Comparison of standard construction aircraft landing gear door (left) with simplified design (right) made possible by metal-bonding and sandwich materials.



Future Uses: At present, structural adhesive applications have been confined largely to the aircraft industry where the weight savings afforded are of considerable value. Aircraft uses are expected to increase. As further research and development make cost reductions possible, high-strength metal-to-metal bonding may be expected to spread to all branches of industry. Sandwich material may find many uses in housing, including components such as walls, roofs, floors, sink tops, doors, and partitions.

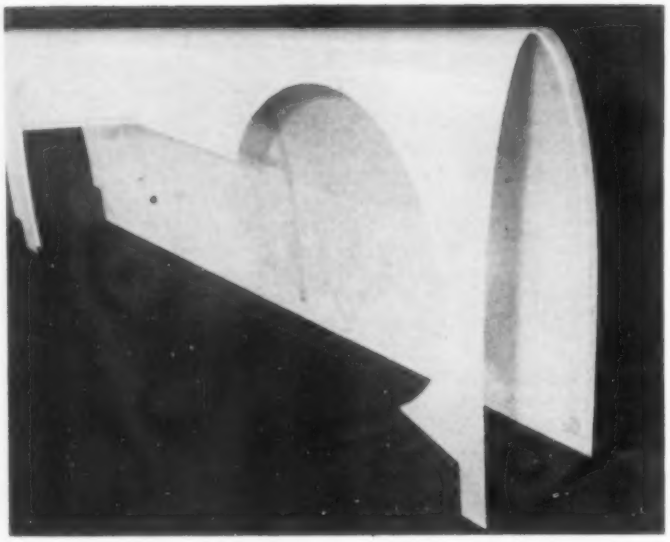


Fig. 7. Complex shapes of honeycomb aluminum alloy, such as this wing leading edge, have been fabricated successfully.

Possibilities in the production of furniture are attractive also. Metal furniture with the appearance of wood can be made by bonding a thin ply of the desired wood onto the metal. Tests have shown that such surfaces will not be marked by a cigarette, no matter how long the lighted end remains in contact. Additional applications are anticipated in railway coaches and ship superstructures. In the automotive industry the rigidity, lightness in weight, and sound-reduction possibilities should make sandwich material attractive for passenger cars. Sandwich materials have already been used to some extent in truck bodies, where, in addition to advantageous structural properties, their inherent heat insulation is frequently useful.

Future Developments: Continued research and development of adhesives may be expected to give increased strength at elevated temperatures; reduction in the curing pressure, temperature, and time; less stringent cleanliness requirements; longer working life (or pot life); improved resistance to impact at low temperatures; reduced cost.

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Interrupted-Cut Problem Trimmed in Tooling

An agricultural equipment producer reduced machining costs resulting from severe interrupted cutting, by rough turning his cast iron corn-husker rolls with a clamped-on-tip cemented tungsten carbide tool on a 10-horsepower lathe. These rolls, which contain many hard spots and sandy inclusions, have numerous grooves on their long slender bodies which present unusually severe interrupted cutting conditions.

Unusual pounding is set up by these interruptions causing the rolls, which are 3¾ inches in diameter and 64 inches long, to chatter to such a degree that the cross-slide feed handle has to be fastened down with a C-clamp to prevent creepage. A roller steady-rest was attached to the cross-slide to support the workpiece. However, this helped very little since it bounced along with the cross-slide at each interruption.

Initially this operation was run with high-speed steel tools which required regrinding after turning only 3 pieces. In an attempt to reduce frequent tool changes and increase production, Kennametal K-6 cemented tungsten-carbide tools were applied to the job. The tools turned 350 pieces before any regrinding was required, representing 115 times greater tool life.

First tool tried on the job was a standard brazed-on-tip type. To prevent breakage occasioned by the severe interruptions, it was found necessary to modify the tools. Therefore back rake was increased to 15 degrees negative, and the end cutting-edge angle to 30 degrees, while the nose radius was increased to 1/16 inch. This tool averaged about 350 pieces per grind. What little breakage resulted was traced to inherent brazing strains aggravated by the severe interruptions.

To correct this condition, a clamped-on-tip tool with similar modification was applied. With its thermal-strain-free assembly it eliminated breakage and continued to produce 350 pieces per grind. This extended life reduced tool grinding by approximately 99 percent.

After changing to cemented tungsten-carbide tools, revolutions and surface feet per minute were doubled to 80 and 78.5 respectively. Feed was increased from 0.030 to 0.044 inch with depth of cut remaining the same at 1/8 to 1/4 inch. Turning time per piece was reduced from 39 to 15 minutes and 16 pieces produced per 8-hour shift as compared to 11 for the high-speed steel tooling setup.

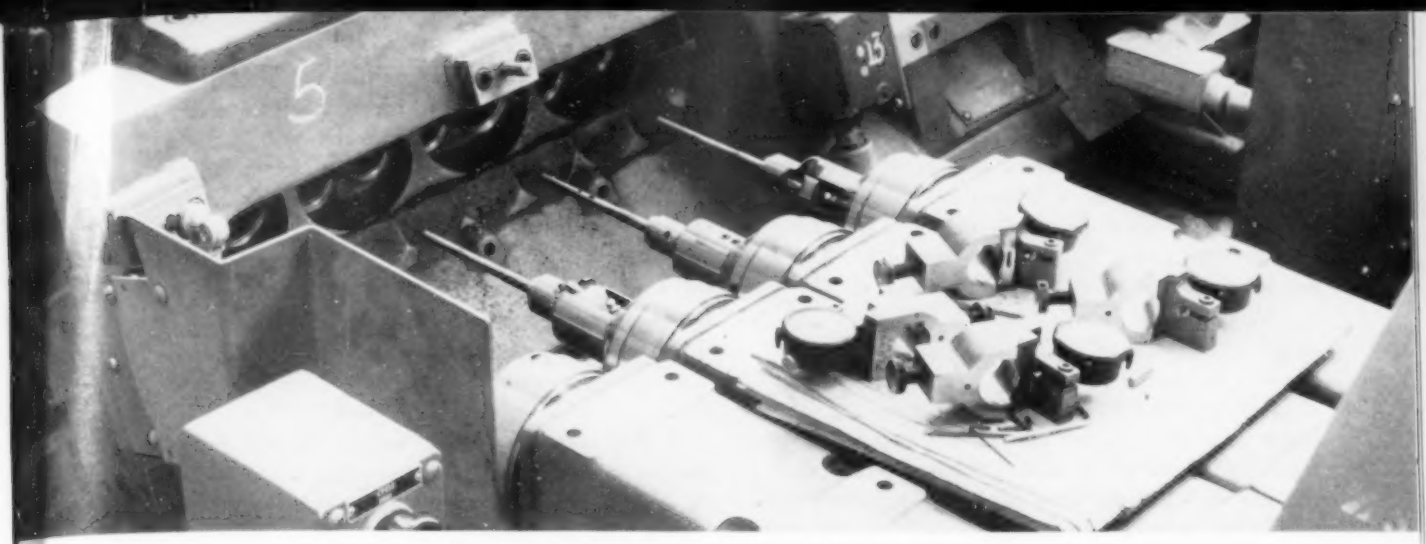

Fig. 1. Boring valve stem holes and simultaneous generating of valve seats on an automotive cylinder head.

Solving Production Boring Problems

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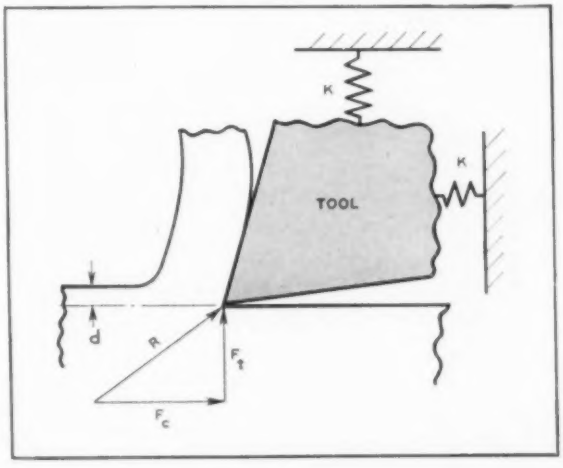
PRECISION BORING is often plagued with certain difficulties caused by elastic effects, thermal effects, friction, wear, and vibration. Successful precision boring, *Fig.* 1, often depends on overcoming one or more of these effects. These difficulties may be controlled or minimized in order that satisfactory production and precision can be attained.

Supposing a hole is being bored satisfactorily with a tool at the end of a boring quill, but that we wish to increase production. Production rates can be increased by increasing the cutting speed and keeping the lead constant; or by increasing the lead and keeping the speed constant. The first method would likely shorten tool life. The second would produce a rough finish because of the large lead and would be unsuited to meet the requirements of precision.

One naturally proposes then to increase the radius of the tool in order to retain the finish at the higher lead. When this is done it will often be found that chatter occurs. In general it is impossible to increase indefinitely the speed or the lead and tool radius. Either the problem of tool life or chatter confronts us. Therefore, advances in the fundamentals of the boring process center around the mitigation of tool life or chatter difficulties.

Chatter: *Fig.* 2 represents a cutting tool held in engagement with the chip by the quill which may be represented by the springs *K*. At some instant during cutting, if the tool is given a slight jar or

Fig. 2. Illustration of tool cutting emphasizing the spring-like action of the boring quill.



Abstracted from Paper 21T2 "Advances in Precision Boring" presented before the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society headquarters.

bump, a greater depth of cut will result. Under certain conditions, the tool and free end of the quill build up into a more or less steady vibration technically known as a self-excited vibration. If the quill is rather long it will usually be vibrating as illustrated in *Fig.* 3. This phenomenon of chatter has been discussed recently.[1*]

Any simple oscillatory system is, in effect, composed of a spring or springlike element K, a mass M, and an energy dissipating element or dashpot c as shown in *Fig.* 3*b*. Generally speaking, the larger K and c are, the greater is the permissible width and depth of cut without chatter. The exact relation between these variables is as yet obscure.

Quill Design: In view of the desirability of having a large stiffness or spring constant K (the rate of change of applied force with respect to displacement) and a large dashpot strength c (the rate of change of applied force with respect to vibrational velocity) in order to prevent chatter, certain features of quill design may be of interest.

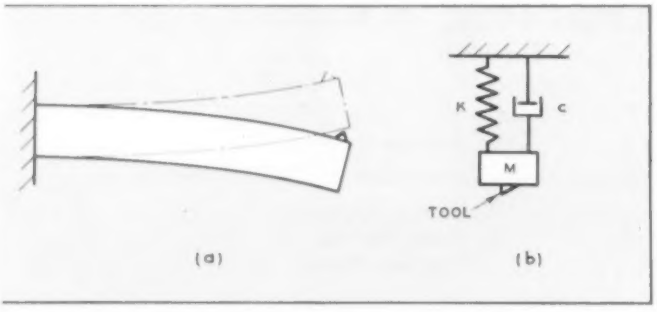


Fig. 3. Fundamental mode of vibration of a quill is shown at *a* and its equivalent simplified vibratory system at *b*.

A quill is naturally made as large as possible without interfering with the sides of the hole or the chips. It is also made no longer than necessary. It should be emphasized that increasing the length of the quill by, say 10 percent, does not reduce the stiffness K by 10 percent, but reduces it by a much larger quantity. Similar changes in quill diameter produce much larger than proportional changes in stiffness K. The stiffness K of a quill varies directly as the fourth power of the diameter and inversely as the cube of the length.

The use of solid tungsten carbide quills permits about 250 percent increase in stiffness over steel quills. These quills, however, have not always shown less susceptibility toward chatter. The reason for this lies in the fact that the internal damping or dashpot strength is usually less for tungsten carbide than for steel.

Instead of relying on the natural internal damping of steel or carbide, which is small in either case, damping may be built into the quill. Such a damper [2] is illustrated in *Fig.* 4. An inertia weight m is fitted with the proper clearance in a cylindrical cavity near the free end of the quill. Should the quill start to vibrate laterally, the inertia weight will tend to remain at rest (laterally) and the fluid in the clearance space (usually air on small quills) will tend to be pumped from one side to the other. The vibratory energy is dissipated in the fluid film.

In this way the inertia weight is said to be coupled to the quill. If the coupling is too strong the inertia weight moves with the quill as though it were solid and there is little or no relative motion between weight and quill and consequently no damping. If the coupling is too weak there will be relative motion between the two, but still, little energy will be dissipated resulting in ineffectual damping. The optimum coupling is controlled by the combination of clearance and fluid viscosity.

The quill damper as shown in *Fig.* 4 often works very satisfactorily but under certain conditions it may be found unsuitable. For instance, in large quills rotating at low speed the relatively large inertia weight will lie upon the bottom. With the usual size of quill the inertia weight is floated in the hole in the quill, the weight and quill behaving in a manner similar to a journal and bearing, both of which run at the same speed but with a rotating load vector. The position of the weight is determined by Sommerfeld's Variable S[3]. In this case it becomes necessary to design the damper so that, in addition to having the optimum coupling it also operates with a satisfactory Sommerfeld Variable S (say $S \geq 0.08$). At very high rotative speeds the inertia weight may also become ineffective due to the effect of centrifugal force. Here it is necessary to incorporate into the design, centralizing springs between the weight and quill in order to nullify the effects of centrifugal force.

In certain cases it has been found desirable to damp the quill in another manner. Generally, the role of cutting fluids in precision boring is identical with that in other machining operations. However, under certain circumstances it may be desirable to utilize the viscous property of the fluid as a vibration dampening agency interposed between the quill and finished bore.

Aggregation of Operations: In order to insure concentricity, precision of alignment, etc., much is to be gained by boring and turning or boring and facing in one combined operation. If a hole can be successfully bored, other surfaces finished at the same time from the same spindle will be concentric or square with the bore. An illustration of this is found in *Fig.* 1 wherein the hole for the valve stem is bored simultaneously with

*1. References are tabulated at end of article.

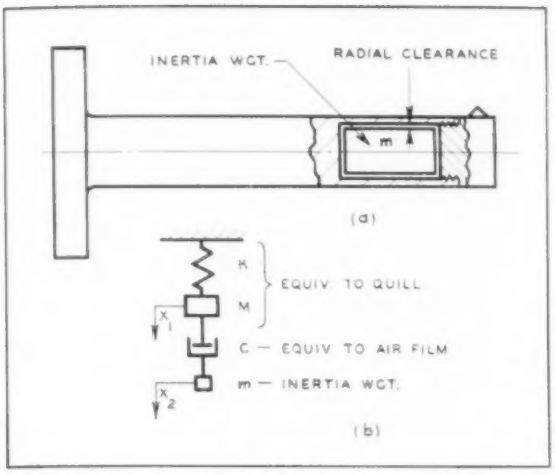


Fig. 4. Damped quill showing equivalent dynamical system.

the valve seat generating operation on a typical automotive head.

Other Elastic Effects: In some applications where a short stiff quill is used in conjunction with some other tool block mounted on the spindle, out of round holes may be produced. The unbalanced centrifugal forces on the spindle often cause the boring head to deflect more sidewise than vertically thereby producing elliptically shaped holes. These quills and spindles must be accurately balanced if round holes are to result.

In *Fig.* 5, a small, radially movable tool block slide *A*, is mounted on the end of a boring head spindle. During rotation, as the tool block slide is fed radially outward (for instance while generating the tapered valve face) it would naturally become greatly unbalanced, were it not for the two balancing weights *B* which are also automatically moved outward to continually balance the tool block slide. In this way reasonably high speeds can be utilized and balance continually maintained.

When two or more boring heads are mounted on the same structure and are run at the same speeds there sometimes occurs a beat between the heads which causes a poor finish. This beat is caused by the unbalance of one head gradually getting in phase with that of the other and then gradually out of phase again due to slight speed differences. This difficulty again may be corrected by accurate balancing.

The main purpose of precision boring is to remove errors in the rough hole. Suppose, for example, the axis of the rough hole runs off at some small angle α_r to the desired axis as illustrated in *Fig.* 6. After the hole is finish bored, how accurately will its axis follow the desired axis of rotation and what factors are involved? To what degree will the finished hole follow the rough hole? It may easily be shown that the eccentricity at any section of the finished hole is related to the original eccentricity of the rough hole by

$$e_f = \frac{K_w}{K_w + K_q} e_r$$

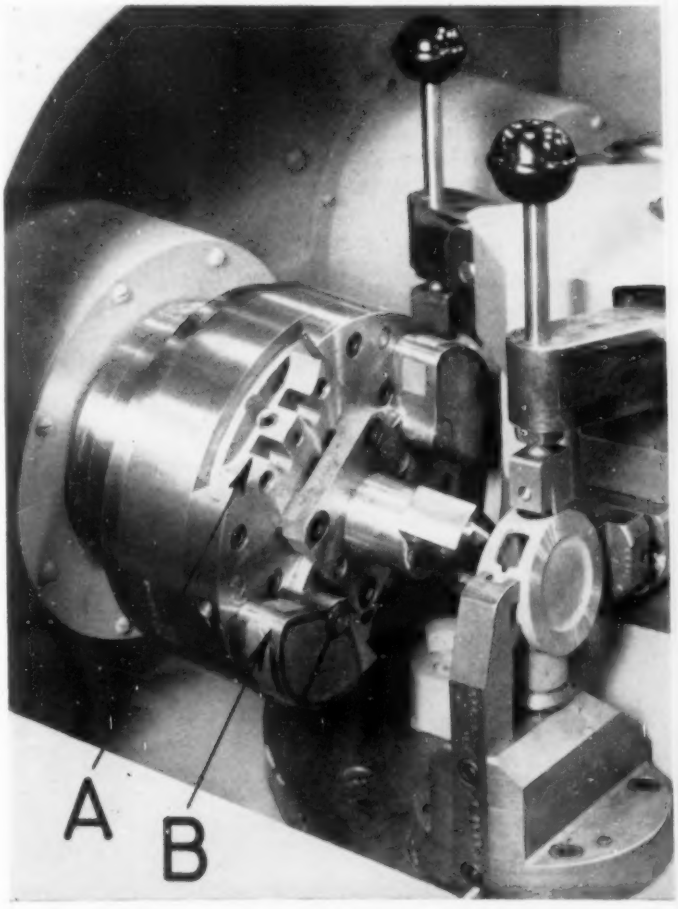
where e_f = Eccentricity of finished hole
e_r = Eccentricity of rough hole
K_w = Work Constant (the rate of increase of thrust force with respect to depth of cut)
K_q = Spring Constant at the tool point.

The alignment angle α_f of the finished hole is related to the angle α_r of the rough hole by the same expression when the eccentricities are replaced by the corresponding angles.

It will readily be observed that the greater the stiffness of the quill K_q, the less will be the finished eccentricity or angle of misalignment. The use of carbide quills in maintaining greater precision is therefore evident.

In case the hole is "two-way" bored, i.e., bored once on the in-stroke and bored again on the out-stroke taking a depth of cut on the out-stroke

Fig. 5. Self balancing cross feed unit generating a valve face. Radially moving tool slide is shown at *A* and automatic balancing weights at *B*.



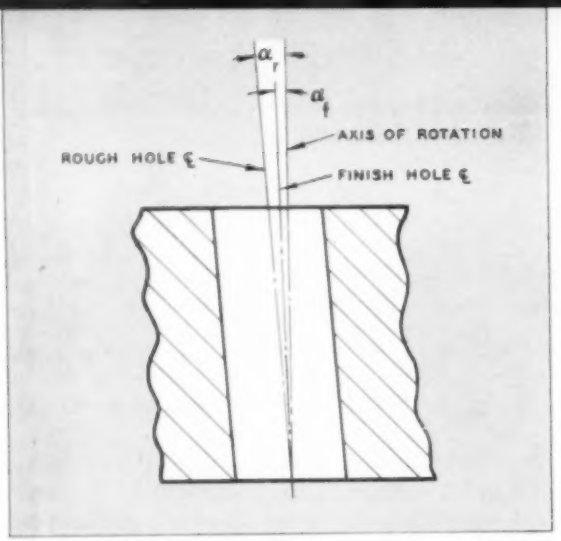


Fig. 6. Misalignment relations of a rough and finished bored hole.

approximately equal to the quill deflection during the in-stroke, the finished hole eccentricity e_f is given by

$$e_f = \left\{ \frac{K_w}{K_w + K_q} \right\}^2 e_r$$

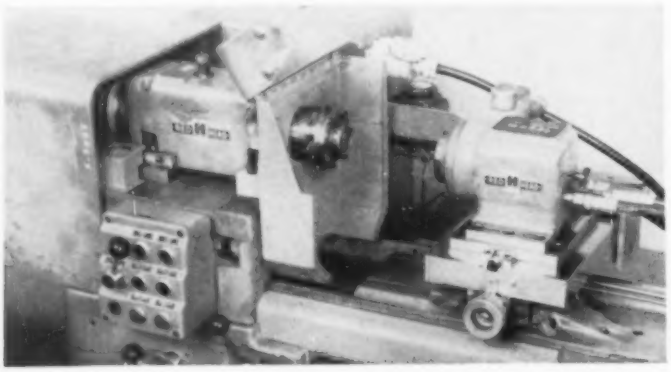
In other words the precision will be considerably increased over one-way boring. As previously, eccentricities may be replaced by corresponding angles to determine the alignment angle.

In some cases of two-way boring a difficulty may sometimes arise. This is due to the fact that a slightly worn tool attempting to take a very shallow cut on a work-hardened surface (due to the previous cut) is likely to rub and take no cut.

Tool Life: Although no outstanding advance in tool life has been made since the introduction of carbide tools there are several factors which may be of interest.

In the case of boring steel holes, having some sort of interruption such as a keyway, difficulty is often encountered. The cutting edge often chips. Failure of a tool by chipping should be distinguished from tool failure by flank or cratering wear.

Fig. 7. High-frequency head carrying a burr at 100,000 rpm for finishing the bore of small ball bearings.



It appears that this mode of failure often occurs as follows: the chip being formed by the tool welds or freezes to the tool face when the tool drops into the interruption (the tool-chip interface temperature drops extremely rapidly as the tool traverses the interruption); the tool with the chip frozen to its face then abruptly engages the workpiece again and the new chip drives off the old chip but since the old chip has frozen to the tool face, it often takes a piece of the tool with it. Under certain conditions where the chip does not freeze to the tool, considerably harder grades of carbide can be successfully used without chipping.

Tool wear is also believed to be related to chatter. Residing on the extreme tip of the tool is usually a built-up edge. Under chattering conditions this edge may be periodically lost and may take with it a fragment of the tool.

Very large increases in tool life have occasionally been achieved by using the end of a circular cylinder of carbide, mounted in a suitable holder to permit rotation, as a cutting tool. This method in which the circular cutting edge rotates transversely under the chip during cutting was first proposed by James Napier in 1868 and might be called Napier's cutting process. The rotary tool can be arranged so that the traction of the chip across the end face of the tool causes it to rotate, or it may be driven by some external agency.

An example in which remarkable tool life is attained is to be found in the finishing of miniature ball bearings by the use of carbide burrs running in the neighborhood of 100,000 rpm. These burrs are on the order of 0.090 inch in diameter or less. They are fed through the hole with the geometry of a planetary milling operation using an end mill. *Fig.* 7 shows a typical setup utilizing a high frequency grinding head to rotate the burr.

Conclusion: The problems of tool life, vibration and elastic effects will probably be with the metal-cutting industry for many years. As the plastic behavior of the chip becomes better understood, along with the friction and heating effects at the tool point, advances may follow in tool design and tool material. As the vibratory effects, involving the tool and work material, tool shape and vibrational properties of the machine surrounding the tool and work, become better understood further advances are likely.

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2. "Design of Lanchester Damper for Elimination of Metal-Cutting Chatter," R. S. Hahn, *Transaction ASME*, Vol. 73, pp. 331-335, April 1951.
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Economics of Spinning and Drawing

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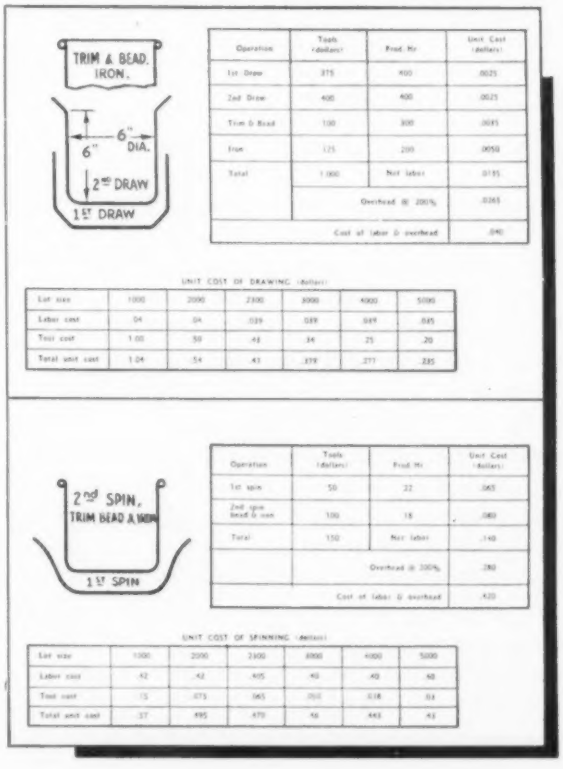
SHAPING BY PRESSING can be used for circular as well as noncircular products within the capacity of the presses used. Spinning, however, is limited to products which are circular in cross sections at right angles to the axis of rotation, except for some minor work which can be done on ovals. Within its field, its scope is wide and in fact only limited by the size of the equipment and the power available to make the metal flow. An evaluation of the two processes, therefore, must be confined to circular products which can be made on either type of equipment. It will be shown that spinning can be competitive as well as supplementary to press drawing and that each process is logical under certain sets of circumstances.

The factors which influence the decision to use either spinning or drawing are basically economic and depend largely on the quantity required. When the equipment for both processes is available, spinning is an alternative to drawing and, before deciding on the use of either process, the following factors should be considered.

1. Tool cost per unit by both methods. This will vary with lot sizes.
2. Labor and overhead cost per unit. This is more or less constant regardless of quantity.
3. Delivery requirements.
4. Contour problems.
5. The possible use of both methods, each doing a part of the work.
6. Dimensional accuracy requirements.

Hand spinning is predominantly a manual operation and as such usually involves high labor costs. The nature of the operation, however, permits the use of simple and economical tooling. It can often be mechanized and, although this may increase tool and equipment costs, it brings unit labor costs closer to those of drawing.

Fig. 1. Comparison of unit costs for producing a six-inch aluminum utensil by drawing and by spinning.



* **Abstracted from paper 21T8, "An Evaluation of Drawing vs Spinning" presented before the 21st ASTE Annual Meeting. Copies of the complete paper will be available from the Society Headquarters.**

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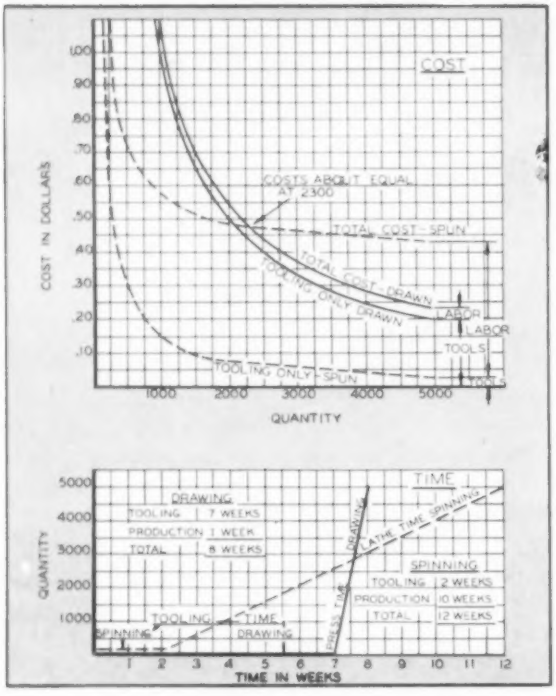


Fig. 2. From the curve at the top it is possible to determine the quantity at which drawing becomes more economical. The graph at the bottom shows the effect on delivery of the two methods.

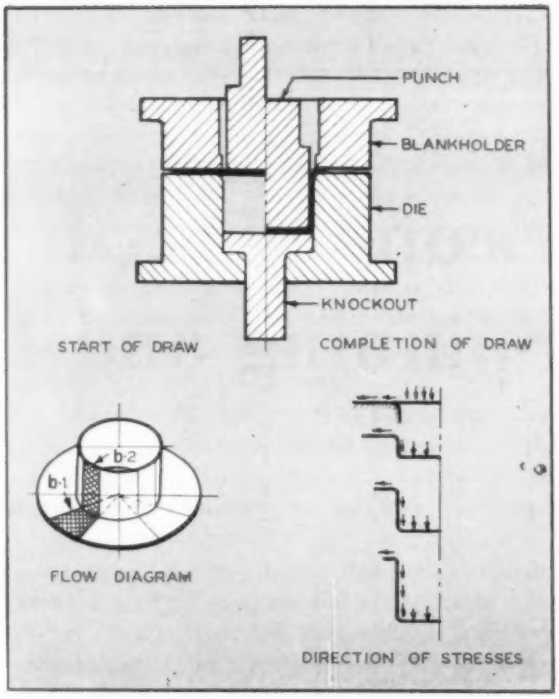


Fig. 3. (top) Double action press draw tool. (bottom, left (A flow diagram for this drawing operation. (bottom, right) Direction of stresses during four stages of the draw.

Drawing is a mechanical operation capable of low labor costs, but requires more costly tooling. These components of the cost factor must be analyzed in relation to lot size before a comparable cost can be obtained.

As stated, tool costs vary with quantity. Labor cost is more or less constant. Hence, the total unit cost including tools is largely dependent on the cost of the tools necessary to do the work. Since the variable in both cases is the cost of tools which in spinning is a low component and in drawing a high component, it follows that the unit cost of a drawn product would drop more rapidly with an increase in quantity than it would with a spun product. However, up to a certain point in the quantity scale the high cost of press tools may bring the unit cost above that of spinning, and it is this demarcation point which must be determined when analyzing the probable cost of drawing or spinning the product.

The details of tool and manufacturing cost of an aluminum utensil 6 inches in diameter by 6 inches deep are shown in *Fig.* 1. The costs are approximate but are reasonably correct for a product such as this when made by either drawing or by hand spinning.

To make this shell on a press, two draws would be required, as illustrated at *A*, followed by a lathe operation to trim the flange and roll the bead, and another lathe operation to burnish the shell walls preparatory to buffing. The latter two operations could also be done in presses but the tool cost would be much higher and since the shell is circular these two operations can be quickly and economically done in a lathe with less outlay for tools.

The labor and tool cost for each operation is shown as well as the unit cost of production based on six different lot sizes. The sharp reduction in unit cost as the quantity is increased is due to the rapid drop in tooling costs with each increase in quantity.

If all these cost values are plotted on a chart and press cost values are superimposed on those for spinning, the demarcation point becomes evident as shown in *Fig.* 2. In the upper graph, the full line curves are drawing costs and the dotted line curves are spinning costs. The lower curve of each pair represents tool costs only; the upper curves represent tool plus labor and overhead costs. The rate of change per increment of quantity on both tooling curves determines the rate of change in the unit cost curves, because production costs are reasonably constant for any quantity.

The intersection of the unit cost curves is the quantity demarcation point beyond which it becomes more economical to draw. In this particular case the costs are about the same at 2300 pieces. At 5000 pieces the cost of drawing is about one-half that of spinning. If the quantity involved was substantial and the shape was one adaptable to mechanical spinning, the effect of mechanization

would be to lower spinning costs to a point where they were more competitive and in some instances lower than the costs of drawing.

Delivery: Delivery is more often than not a critical factor and production cannot begin until the tools are on hand. The tools for hand spinning can be built in much less time than draw tools and this makes possible an earlier start on production. However, it must be emphasized that once the draw tools are working they produce at a much faster rate, and if the quantity is large enough, it may be possible to complete the job in a shorter span of overall time. This is illustrated in the lower set of curves at *B*, which show that up to a certain quantity spinning is competitive from a delivery standpoint, but beyond that quantity the faster production by drawing becomes effective.

Future Orders: If future orders for a specific product are a reasonable possibility, the economies are changed somewhat. Tooling is usually absorbed on the first order and is not a factor on repeat orders. This would give pressing a decided cost advantage, and the overall effect of including future runs into the calculations is to lower the demarcation point which determines when drawing becomes more economical.

Contour Problems: Re-entrant contours are frequently required in such products as kettles, bottle shapes, washing machine tubs, etc., and such contours are usually more easily produced by spinning than by pressing. Re-entrant contours can be spun on sectional chucks or on internal roll units in fewer operations than such shapes can be press-formed. It is difficult and sometimes impossible to provide internal support for the metal being necked-in on a press tool, whereas a sectional chuck or an internal roll provides full support while spinning and makes it possible to produce a smoother finish on the work.

Fig. 4. Typical spinning setup for the same type of shell shown in *Fig.* 3. The diagram at the lower left illustrates the technique of hand spinning. The first step is shown in detail at the right.

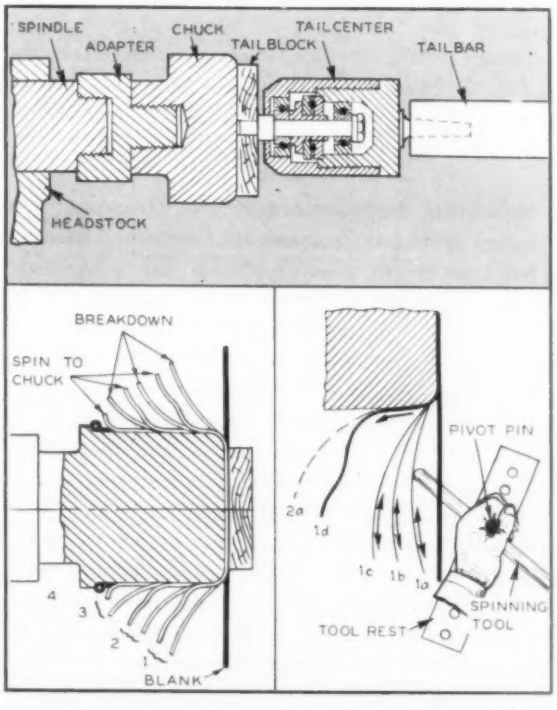


Fig. 5. Breakdown operation on a 0.081-inch aluminum shell.

Using Both Processes: Often it is possible to arrive at economical costs by using both drawing and spinning to make a shell. Plants regularly making deep drawn circular products usually have a system of standardized tools for breakdown operations which are used for several products. By drawing a blank on a standard set of dies and spinning this drawn shell to its final shape, tool and labor costs can often be reduced.

Dimensional Accuracy: Greater accuracy of size and wall thickness, and better uniformity are possible on drawn work than on spun work, on which a tolerance of plus or minus 1/32 inch is as close as can be guaranteed on a hand-spun product. These limits for spinning, however, can be improved when the spinning tools are mechanized.

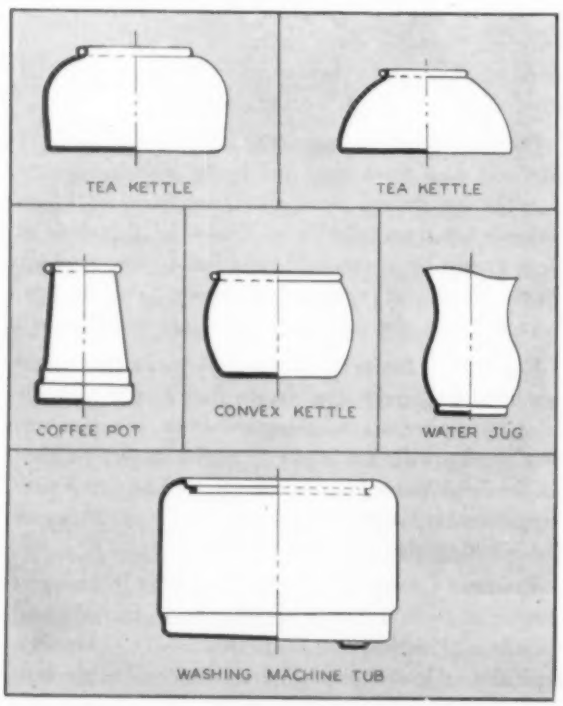
Capacity Limits: The press is limited to a certain die size, maximum drawn depth, and tonnage capacity, whereas a spinning lathe can, if necessary, be altered to swing a larger blank by merely jacking up the head and tail stock. It can also be fitted with supplementary equipment for special operations or for boosting the spinning pressure.

Process Comparison: It would be in order at this point to compare the processes of drawing and spinning. The diagram at the top in *Fig.* 3 shows a typical double action press draw tool and at the bot-

tom, left, a flow diagram. The tool consists of a punch to actuate the movement of metal, a die into which the metal is drawn, and a blankholder to control the wrinkling tendency of the metal being drawn. The faces of the die and the blankholder as well as the radius over which the metal is drawn must be smooth so as not to retard flow, and the tools and metal must be lubricated for the same reason. The pressure applied by the blankholder must be sufficient to prevent the formation of wrinkles, but not enough to retard flow.

In the flow diagram, *Fig.* 3, one section of the blank has been outlined by two radial boundaries and that part of the section marked *b-1* is the material which makes the side-wall section *b-2*. In the process of drawing, the angular shape must be made to flow into a parallel sided shape on the wall of the shell. The thickness of *b-1* must not be thinned out by stretching but must remain reasonably constant in area throughout the change in shape. The outer part of each section in the entire blank undergoes the same change at the same time and this crowding of metal which occurs as the blank is drawn into the die induces compressive stresses tending to make the metal buckle or wrinkle. The punch pressing on the center area of the blank must overcome the retarding effect of the compressive stresses in the flow area, thus putting a tensile stress on the wall metal as illustrated at the right, which shows the draw in four stages. If the punch pressure necessary to overcome the resistance to flow exceeds the strength of the wall section, the shell will fracture at either the top or bottom radius.

Fig. 6. Spinning is a logical choice for producing these six re-entrant contours.



A typical spinning setup for a similar shell is shown in *Fig.* 4. The sketch at the top shows the chuck on which the metal is spun. The tail block holds the work onto the chuck until the shell is spun. For a one-time job the chuck could be hardwood which would be satisfactory for several hundred pieces, providing size and finish requirements of the shell were not too critical. For longer runs, closer tolerance and better finishes, the chuck would be steel and reasonably well polished.

The technique of hand spinning is illustrated at the lower left in *Fig.* 4, showing the metal being gradually moved to the shape of the chuck. The procedure followed becomes through repetition almost automatic to the operator. The knowledge of how and when to vary the technique to overcome problems of metal, shape, finish, etc., comes only with experience. A highly skilled spinner can build up or reduce thickness almost at will and can, because of experience and skill, produce work which is uniform within the limits of the process.

Each spinner develops his own technique but in general the procedure is as follows: The tool is moved in a series of long and short sweeps semicircular in direction. The long sweep moves a band of metal toward the chuck and the short sweeps lay part of that band down onto the chuck. This cycle is repeated several times, as indicated at the left. Each step is shown in two stages, the breakdown stage being the result of the long sweeps which are followed by short sweeps to lay the metal down to the chuck. The sketch at the right shows the first step in detail to illustrate the action more clearly. When the last area band has been worked down to the chuck, the flange is trimmed and beaded and the wall ironed by burnishing with the back face of the spinning tool. This sizes the shell and gives it an improved finish. A typical spinner's stance is shown in *Fig.* 5. Metals of high spinnability such as aluminum can be given a bright finish by burnishing, reducing the cost of polishing considerably.

Spinning Supplementary to Drawing: A spinning lathe has as many supplementary uses as it has competitive uses. Neither presses nor lathes can do all the work which comes along, but if both types of equipment are available the range of work which can be accepted is much wider. The press can take care of products which cannot be spun and those wherein the quantity makes pressing more economical. The lathe can handle small-lot runs, and assist in the manufacture of many press-drawn products. The capital expenditure involved in the purchase of a press is much higher than for a spinning lathe, but a press has greater earning power because it is logical equipment for large orders. The lathe on the other hand is versatile equipment and useful for many supplementary operations on circular work, such as trimming drawn shells, bead-

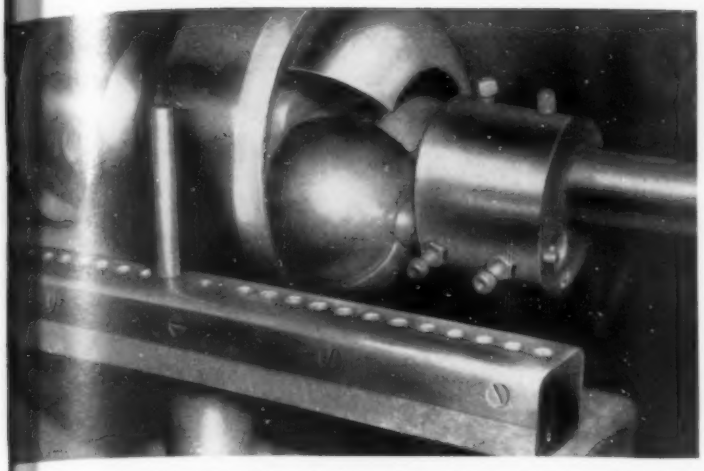


Fig. 7. (Above) A section of the shell has been cut away here to show the roll in spinning position in this internal roll unit.

Fig. 8. (Right) A first draw operation is performed on this 200-ton double action press. The piece is a stainless steel stock pot.

ing, burnishing or ironing, groove rolling, marking of ornamental designs, re-entrant contour spinning, etc. Such operations are all standard operations on ordinary spinning lathes. The lathe can also supplement the press in producing an economical method of making prototypes and models of circular work as a preliminary step to mass production.

Spinning Competitive with Drawing: Under certain circumstances spinning can be competitive with drawing, as for instance on small-lot runs because of low tooling costs. Spinning often becomes competitive because the contour of a shell is either difficult or impossible to produce on a press. Occasionally a shell which is too large for available press equipment can be spun to shape economically, and there are certain products which, regardless of quantity, can be more economically spun than drawn. Special attachments to standard spinning lathes to mechanize tool application, special spinning machines for unusual operations—all are evidence of progress in spinning techniques which tend to close the gap between spinning and drawing.

Table 1—Spinnability of Metals

TYPE OF METAL	SHALLOW SPINNING	DEEP SPINNING
Aluminum, Dowmetal and Magnesium		
Alcan 2S0 and 3S0 aluminum	1.00	1.00
" 57S0 " 55S0 aluminum	.98	.62
" 17S0 " 24S0 aluminum	.65	.45
Magnesium & Dowmetal	.55	.45*
Miscellaneous Soft Metals		
Zinc	.94	.94
Pewter	.94	.93
Lead	.90	.85
Steels		
Cold rolled (Deep drawing steel)	.91	.91
Hot rolled (Pickled drawing steel)	.91	.72
Lead coated (Long ternes)	.90	—+
Galvanized	.82	—+
High tensile	.40	.13
0.40 percent & upward of carbon	.22	.09
Copper and Copper Alloys		
Commercial bronze	.87	.87
Copper (Cold rolled annealed)	.87	.87
Yellow stamping brass	.86	.86
Nickel silver (up to 30 percent)	.85	.75
Phosphor bronze (Soft temper)	.73	.39
Muntz metal	.47	.13
Nickel and Nickel Alloys		
Nickel	.86	.86
Monel (Deep drawing quality)	.86	.82
Inconel	.81	.75
Stainless Steels		
Type 347 (18/8)	.67	.67
Type 430 (14/18)	.67	.53
Type 304 (18/8)	.65	.65
Type 302 (18/8)	.65	.33

* Special setup for hot spinning
\+ Coating will flake

The question naturally arises of what metals can be spun. Spinnability is directly proportionate to ductility and a metal which can be deep drawn can usually be deep spun. This fact may be used as a guide in selecting metals for spinning. The high formability possible by spinning results from the progressive nature of the operation which is equivalent to many successive drawing operations. Metals which are difficult to draw may often be spun but may require more power and possibly the use of heat during spinning or else annealing between operations.

In order to tabulate the property of spinnability, the Milwaukee Metal Spinning Co. has conducted tests on various metals and arrived at a spinnability rating for several of the more commonly used metals. The rating is based on a numerical value of 1.00 for aluminum alloy 2S0 which in the tests indicated maximum spinnability. These values are shown in TABLE 1. Although some of the metals which have good deep drawing properties are also

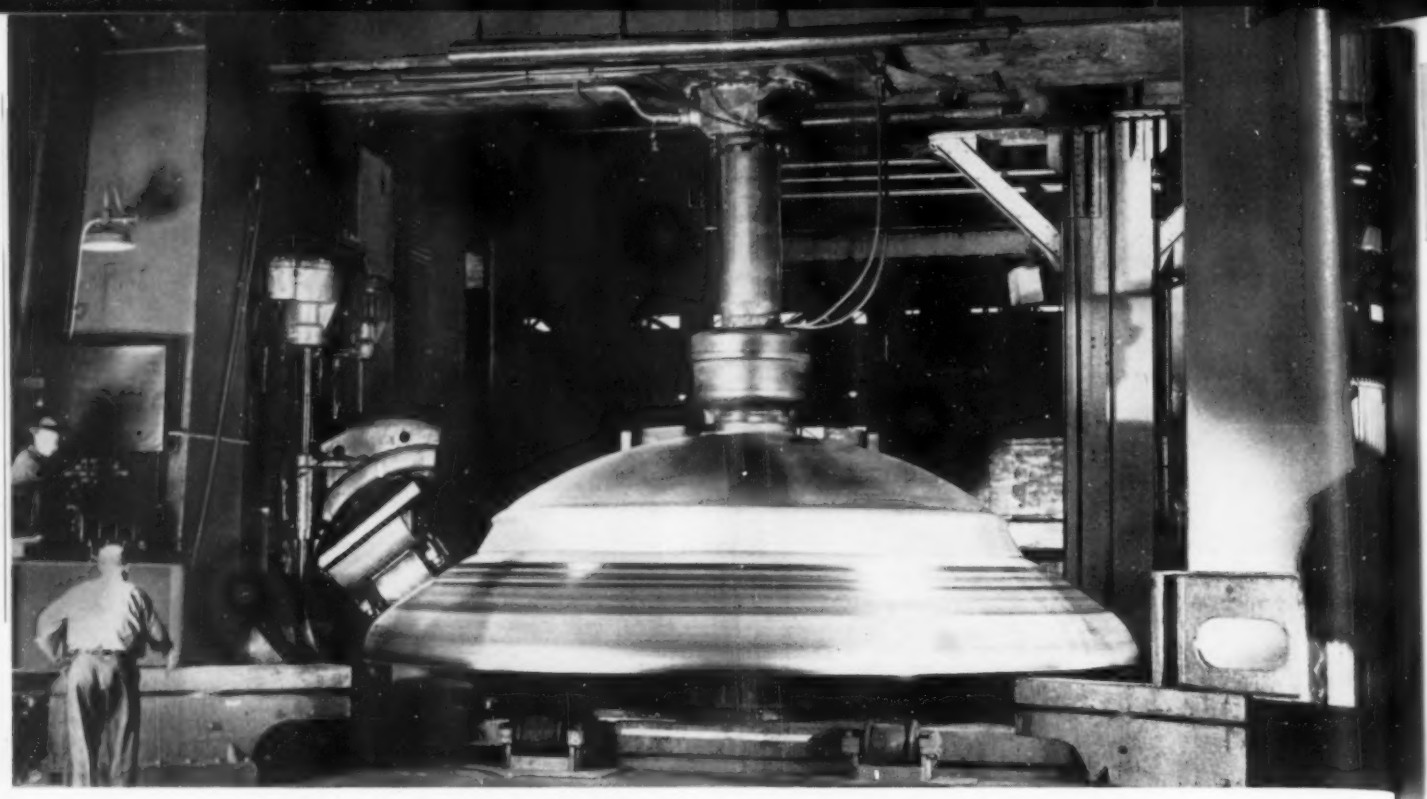


Fig. 9. Special tank head spinning machine produces parts from large steel blanks.

high in spinnability, others which are difficult to draw have fair spinnability.

Considering drawn or spun shells having either parallel sided or tapered walls, it may be stated as a general rule that contours which provide the best control of flow in a drawing operation, do not provide as good control in spinning operations and, conversely, contours providing poor control in drawing operations provide better flow control in spinning operations.

Closed contours can be produced either by drawing or spinning and the half units welded together to make assemblies. In order to facilitate welding it is important to have the joints well matched. If the parts are drawn to shape matching is no problem because the press method is capable of uniformity in product size. In spinning, the human element, fatigue of manual operations etc., tend to lead to variations and to offset this the parts should be paired up as production proceeds.

For the six contours in *Fig.* 6, the spinning process is a logical choice either for complete fabrication or for the completion of shells which have been drawn to a size suitable for the final shaping by spinning. These may be described as re-entrant contours because some part of the wall of each shell is larger than the neck or open end. Each of the shells shown could be drawn to its major diameter, then the re-entrant contour spun down on either sectional chucks or internal roll units.

Internal roll units are capable of higher production speeds than are sectional chucks, because it is necessary to disassemble section chucks after spinning each shell, and reassemble the section on the core of the chuck before the next shell can be spun. In the close-up view of an internal roll unit, *Fig.* 7, a portion of the shell has been cut away to expose the roll in spinning position. In operation a drawn shell having parallel sides is slipped into the chuck, the roll unit which is attached to the tail block is moved into position. The re-entrant contour of the kettle shoulder is then spun to the roll. The roll and the finished kettle are then moved away from the chuck and the shell removed from the roll. This method is more or less standard for seamless kettles and is efficient and economical.

As mentioned earlier, mechanization of some or all of the hand spinning technique leads to lower spinning cost. Thick or tough metal requires pressures far in excess of human brawn, and for these semi-mechanical or fully mechanical means must be used to apply the pressure necessary to make the metal flow, *Fig.* 8.

An outstanding example of mechanical spinning is illustrated in *Fig.* 9. A steel tank head is made by mechanical spinning on this special machine. Heads up to 18 feet in diameter spun from blanks 20 feet in diameter and over one inch in thickness are not unusual, and thicknesses up to 6 inches have also been spun on similar equipment.

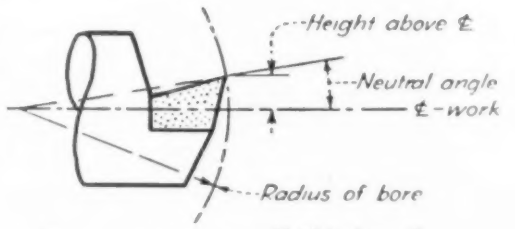
In summary it can be said that each process is logical under certain circumstances. Each is capable of the complete manufacture of products within its scope, and both can be used on some products to good cost advantage. Hence they can compete with as well as supplement each other, and whether one or both processes are used depends mainly on the economics of each individual case.

Precision Boring

When establishing the details of setups for precision boring, some factors that must be considered are: (1) the effects, with respect to back rake and end relief (bore clearance angle), produced by setting the tool nose above the center line of work rotation, and (2) the actual end-relief that must be ground on the toolbit so the proper amount of side clearance is obtained when the tool is set at an angle in the quill.

The charts, diagrams and tables presented are from data compiled by The Heald Machine Co., Worcester, Mass. They provide general basic principles of tool design and related information such as coolants, cuts and leads for use with various materials under varying conditions, but the final determination of the most efficient shape, nose radius, setup, speeds, etc. for a new job is frequently a matter of experimentation.

Variations in True Rake Angles*

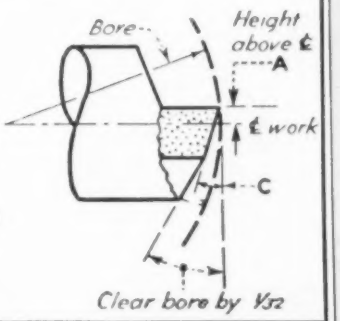


Sine "neutral angle" = $\frac{\text{Height above ℄}}{\text{Radius of bore}}$

DIAMETER OF BORE (inch)	HEIGHT ABOVE CENTER LINE (INCHES) NEUTRAL ANGLE (DEGREES)					
	0.010"	1/64"	1/32"	1/16"	3/32"	1/8"
5/16	4	6	11½			
⅜	3½	5	9½			
7/16	3	4	8			
½	2½	3½	7			
⅝	2	3	5½	11½		
¾	1½	2½	5	9½		
⅞	1	2	3½	7½	12½	
1	1	2	3½	7	11	
1¼		1½	3	6	8½	11
1½		1	2½	5	1	9½
1¾		1	2	4	6	8
2		1	2	3½	5½	7
2½		1	1½	3	4½	6
3			1	2½	3½	5
3½			1	2	3	4
4			1	2	3	3½
5			1	1½	2	3
6				1	2	2½

Bore Clearance Angles

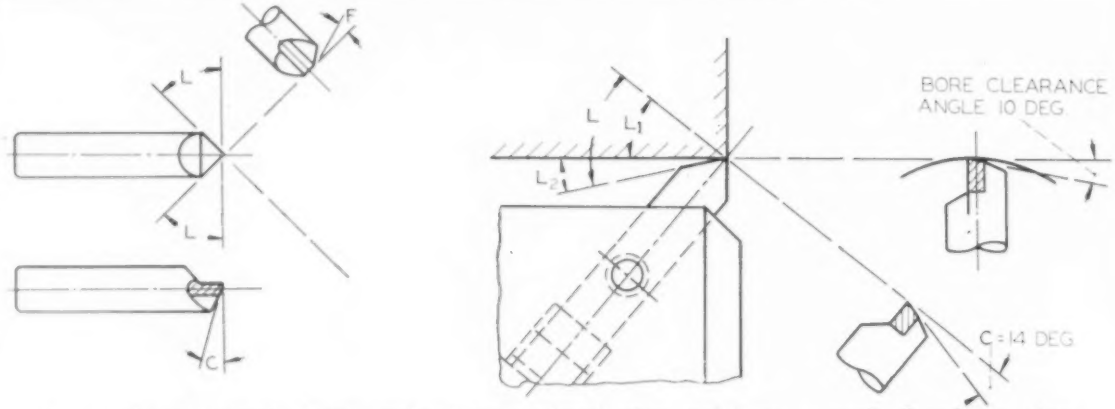
MATERIALS	
Group 1	Group 2
Brass	Aluminum
Bronze	Copper
Cast Iron	Fiber
Cast Steel	Magnesium
Malleable Iron	Plastics
Semi-Steel	Rubber
Steel	Zinc Alloy



DIAMETER OF BORE (INCH)	BORE CLEARANCE ANGLE C (Degrees) A = 0 Material		A = 0.010" Material		A = 1/32" Material		A = 1/16" Material	
	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2	Group 1	Group 2
5/16	10	13	9	12	3	5	—	—
3/8	10	13	9	12	4	6	—	—
7/16	10	13	9	12	5	7	—	—
1/2	10	13	9	12	6	8	—	—
5/8	10	13	9	12	6	9	2	4
3/4	10	13	9	12	6	9	2	5
7/8	10	13	9	12	6	9	2	5
1	10	12	8	11	6	9	2	5
1 1/4	9	12	8	11	6	9	3	6
1 1/2	9	12	7	10	6	9	3	6
1 3/4	8	11	7	10	6	9	4	7
2	8	11	7	10	6	9	4	7
2 1/2	7	10	6	9	6	9	4	7
3	7	10	6	9	6	9	5	8
3 1/2	7	10	6	9	6	9	5	8
4	6	8	6	9	6	9	5	8
5	6	8	6	9	6	9	5	8
6	6	8	5	8	6	9	5	8

*True rake is the sum of tool rake and neutral angle, using a negative sign for back rake.

Blending Angle for Determining Actual Clearance for Angle-Set Tools

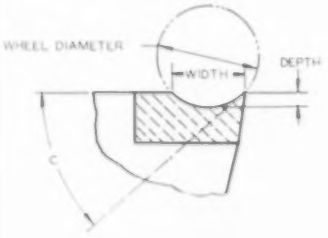


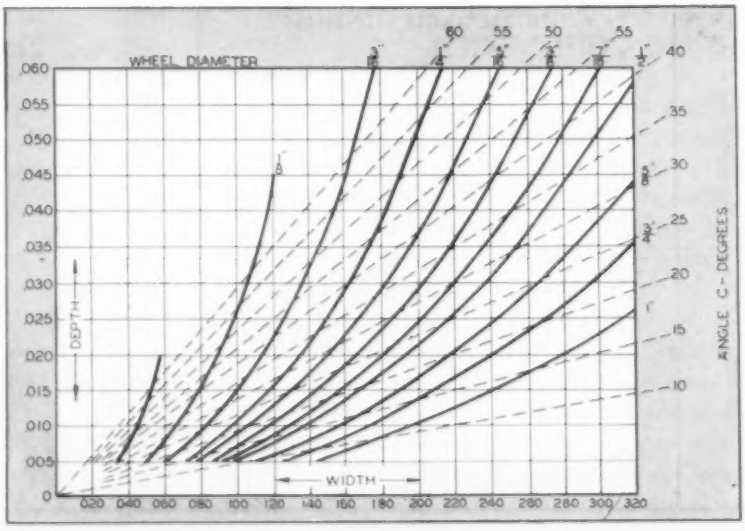
$F = \tan^{-1}(\cos L \tan C)$. Thus, Angles F are produced when tool is set at angle C and any given angles L. Thus, when the tool is set at an angle in the quill, angle F becomes the bore clearance. There is a slight error in this method because the bore clearance is actually for angle L_1 but the error is negligible.

Bore Clearance Angle C (deg)	Side Angle, L (Degrees)											
	5	10	15	20	25	30	35	40	45	50	55	60
	Blending Angle, F (Degrees)											
1	1°-00'	0°-59'	0°-58'	0°-56'	0°-54'	0°-52'	0°-49'	0°-46'	0°-42'	0°-39'	0°-34'	0°-30'
2	2°-00'	1°-58'	1°-56'	1°-53'	1°-49'	1°-44'	1°-38'	1°-32'	1°-25'	1°-17'	1°-09'	1°-00'
3	2°-59'	2°-57'	2°-54'	2°-49'	2°-43'	2°-36'	2°-27'	2°-18'	2°-07'	1°-56'	1°-43'	1°-30'
4	3°-59'	3°-56'	3°-52'	3°-46'	3°-38'	3°-28'	3°-17'	3°-04'	2°-50'	2°-34'	2°-18'	2°-00'
5	4°-59'	4°-55'	4°-50'	4°-42'	4°-32'	4°-20'	4°-06'	3°-50'	3°-32'	3°-13'	2°-52'	2°-30'
6	5°-59'	5°-55'	5°-48'	5°-38'	5°-26'	5°-12'	4°-55'	4°-36'	4°-15'	3°-52'	3°-27'	3°-00'
7	6°-58'	6°-54'	6°-46'	6°-35'	6°-21'	6°-04'	5°-45'	5°-22'	4°-58'	4°-31'	4°-02'	3°-31'
8	7°-58'	7°-53'	7°-44'	7°-31'	7°-16'	6°-56'	6°-34'	6°-09'	5°-41'	5°-10'	4°-37'	4°-01'
9	8°-58'	8°-52'	8°-42'	8°-28'	8°-10'	7°-49'	7°-24'	6°-55'	6°-23'	5°-49'	5°-11'	4°-32'
10	9°-58'	9°-51'	9°-40'	9°-24'	9°-05'	8°-41'	8°-13'	7°-42'	7°-06'	6°-28'	5°-47'	5°-02'
11	10°-58'	10°-50'	10°-38'	10°-21'	9°-59'	9°-33'	9°-03'	8°-28'	7°-50'	7°-07'	6°-22'	5°-33'
12	11°-57'	11°-49'	11°-36'	11°-18'	10°-54'	10°-26'	9°-53'	9°-15'	8°-33'	7°-47'	6°-57'	6°-04'
13	12°-57'	12°-49'	12°-34'	12°-14'	11°-49'	11°-18'	10°-43'	10°-02'	9°-16'	8°-26'	7°-33'	6°-35'
14	13°-57'	13°-48'	13°-32'	13°-11'	12°-44'	12°-11'	11°-33'	10°-49'	10°-00'	9°-06'	8°-08'	7°-06'
15	14°-57'	14°-47'	14°-31'	14°-08'	13°-39'	13°-04'	12°-23'	11°-36'	10°-44'	9°-46'	8°-44'	7°-38'
16	15°-57'	15°-46'	15°-29'	15°-05'	14°-34'	13°-57'	13°-13'	12°-23'	11°-28'	10°-27'	9°-20'	8°-10'
17	16°-56'	16°-45'	16°-27'	16°-02'	15°-29'	14°-50'	14°-04'	13°-11'	12°-12'	11°-07'	9°-57'	8°-41'
18	17°-56'	17°-45'	17°-25'	16°-59'	16°-25'	15°-43'	14°-54'	13°-59'	12°-56'	11°-48'	10°-33'	9°-14'
19	18°-56'	18°-44'	18°-24'	17°-56'	17°-20'	16°-36'	15°-45'	14°-47'	13°-41'	12°-29'	11°-10'	9°-46'
20	19°-56'	19°-43'	19°-22'	18°-53'	18°-15'	17°-30'	16°-36'	15°-35'	14°-26'	13°-10'	11°-48'	10°-19'
21	20°-56'	20°-42'	20°-21'	19°-50'	19°-11'	18°-23'	17°-27'	16°-23'	15°-11'	13°-52'	12°-25'	10°-52'
22	21°-56'	21°-42'	21°-19'	20°-47'	20°-07'	19°-17'	18°-19'	17°-12'	15°-57'	14°-34'	13°-03'	11°-25'

Chip Curler Chart

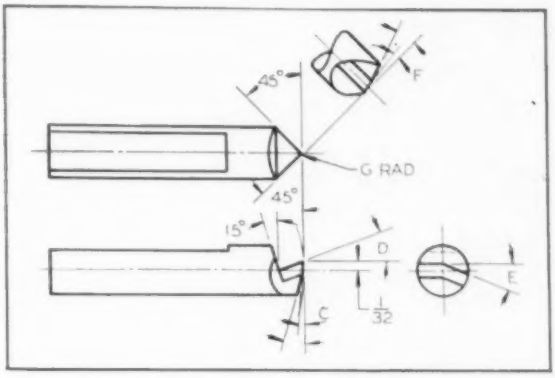
This chart is used to obtain a given amount of rake without creating a chip pocket. Thus, it is possible to control chip size, and if the curler is tipped 2 to 3 degrees either side, the chip will be conducted in the desired direction.





Typical Tool Shapes for Various Metals

Aluminum



Cutting Speeds = 800—6000 sfpm.

Lead = 0.002 to 0.006 inch per revolution.

Depth of cut = 0.005 to 0.015 inch.

C = Clearance Angle. Varies with height of cutting point above center line of tool (see table, Bore Clearance Angles).

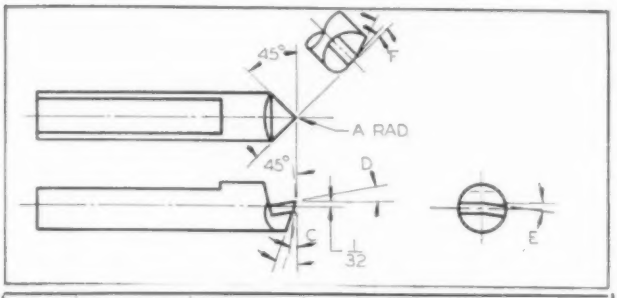
D = Back rake angle = 0 to 15 degrees.

E = Side rake angle = 5 to 15 degrees.

F = Side clearance angle controlled by C (see table, Blending Angle for Determining Actual Clearance for Angle-Set Tools).

G = Radius. Controlled by finish required, feed used and the pressure which can be used on work or boring bar. 0.015 inch radius for small bores; 0.015 to 0.060 inch radius for large bores.

Coolant = soluble oil, soda water, kerosene and lard oil.



Class	Cutting Speed	Back Rake D (degrees)	Side Rake E (degrees)	Coolant
1	800–3000	0	5	Dry; paraffin oil; sol. oil 20 to 1
2	450–1500	0 to 5	5 to 10	Sol. oil; min. oil + 10 percent lard oil
3	200–800	5 to 10	15 to 20	Min. oil + 20 percent lard oil

Bronze

Class 1 (Free Cutting Alloys)

Leaded Copper, Leaded Commercial Bronze, Leaded Red Brass, Free Cutting Yellow Brass, Forging Brass, Leaded Naval Brass.

Class 2 (Readily Machinable)

Red Brass, Yellow Brass, Muntz Metal, Naval Brass, Tobin Bronze, Leaded Phosphur Bronze.

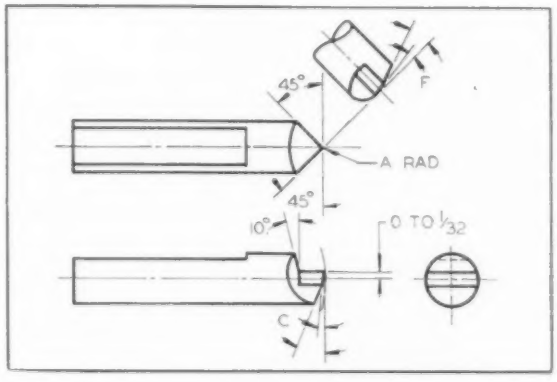
Class 3.

Copper, Commercial Bronze, Nickel Silver, Beryllium Copper, Chrome Copper.

A = Radius controlled by finish required. Average radius 0.015 to 0.030 inch for small bores. Average radius 0.030 to 0.060 inch for large bores.

C = Clearance angles. Change with variation in height above center line of tool (see table, Bore Clearance Angles).

F = Side clearance angles (see table, Blending Angle for Determining Actual Clearance for Angle-Set Tools).



Cast Iron

Lead = 0.003 to 0.006 inch per revolution.

Depth of Cut = 0.005 to 0.015 inch.

Cutting Speed = 300 to 750 sfpm.

A = Radius. Controlled by finish required, lead used and the pressure which can be used on work or boring bar. 0.015 to 0.030 inch radius on small bores; 0.030 to 0.060 inch radius on large bores.

C = Clearance angle. Varies with height of cutting point above center line (see table, Bore Clearance Angles).

For side clearance angles see table, Blending Angle for Determining Actual Clearance for Angle-Set Tools.

Steel

Lead = 0.003 to 0.007 inch per revolution.

Depth of Cut = 0.005 to 0.015 inch.

sfpm = see chart, Boring Speeds for SAE Steels.

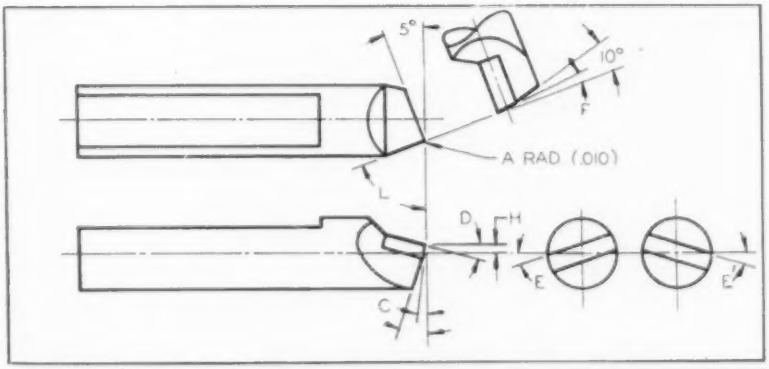
A = Radius (Keep small—approx. equal to depth of cut).

L = Lead angle (not affected by light cuts).

C = Clearance angle (see table, Bore Clearance Angles).

F = Side clearance angle (2 or 3 degrees adequate).

H = Height above center line. It modifies C (see table, Bore Clearance Angles).

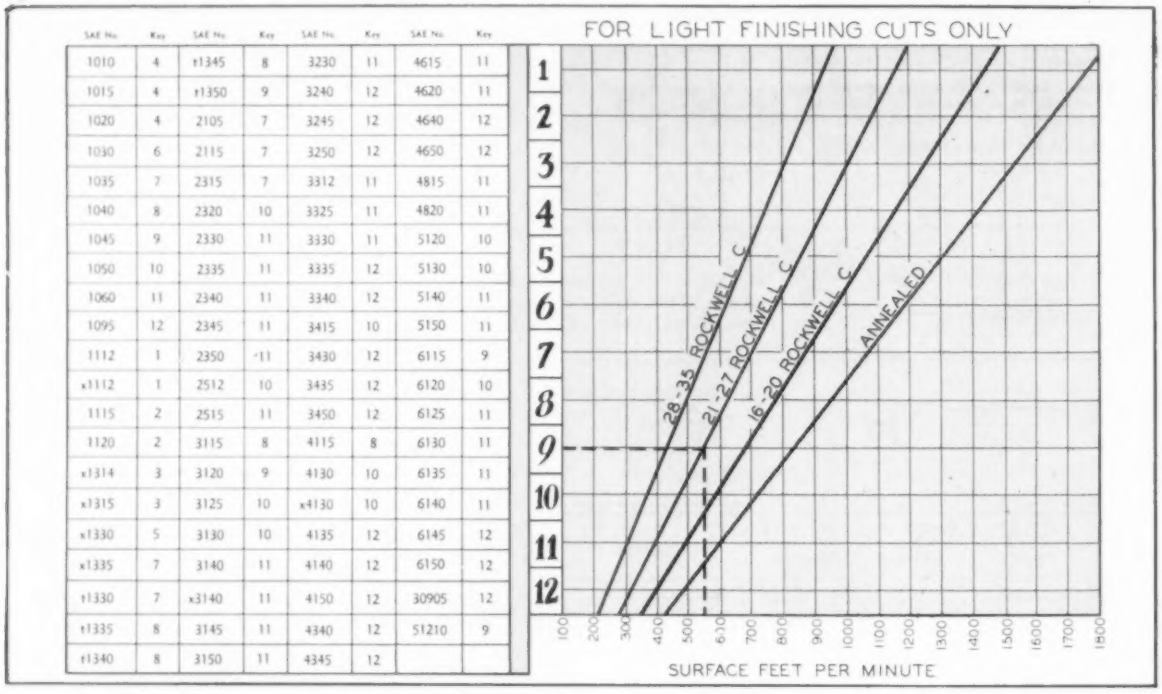


Negative Back Rake (Degree) D	Negative Side Rake (Degree) E	Positive Side Rake (Degree) E'	Use
0 to 6	3 to 8		High Carbon & Alloy Steels
5 to 35		15 to 35	Interrupted cuts & tough Steels
3 to 10		0 to 15	Low Carbon Steels & Free Cutting Alloys

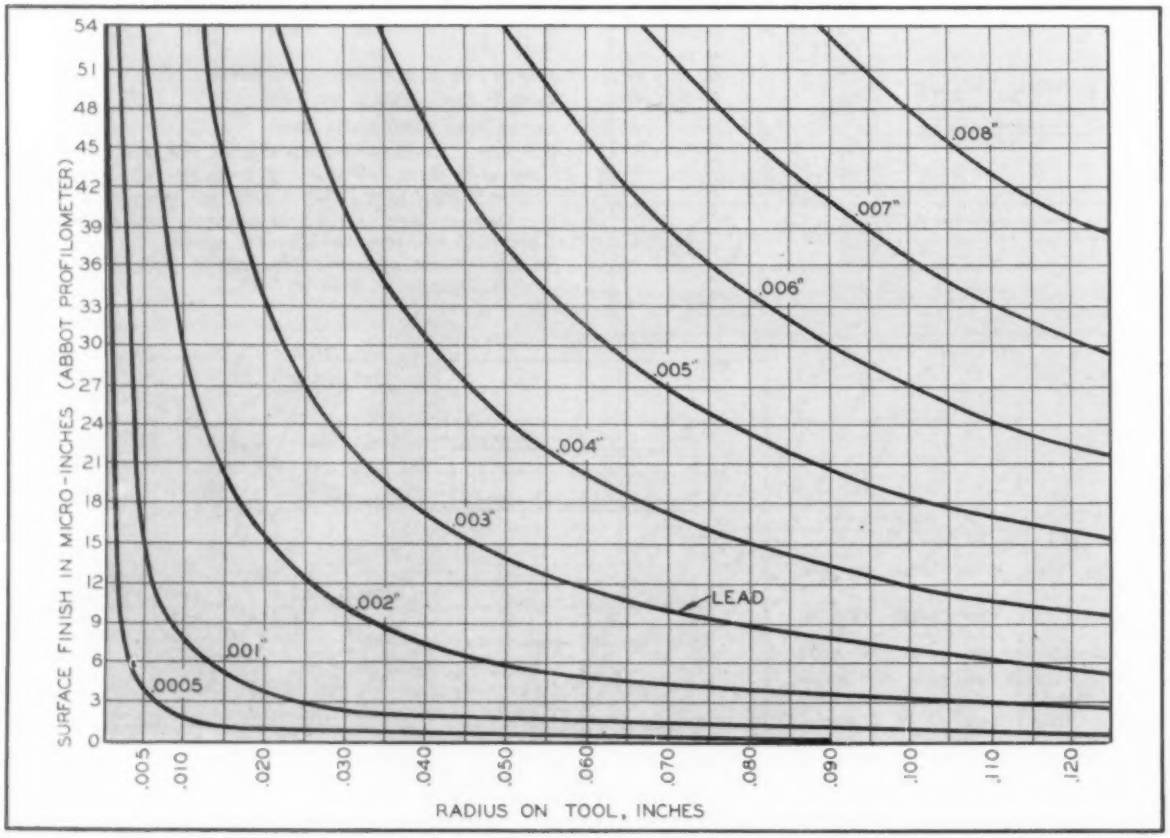
Boring Speeds for SAE Steels

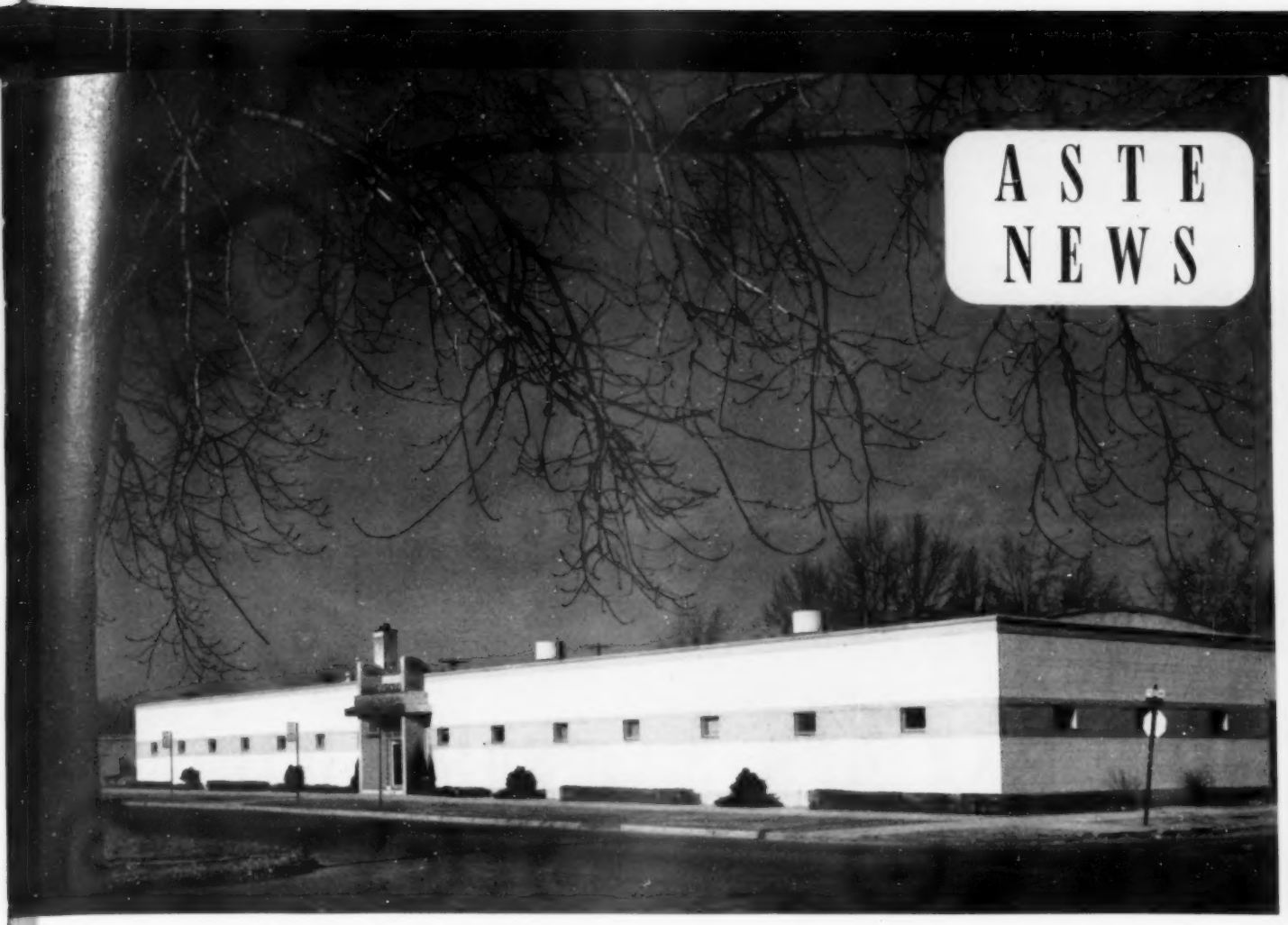
To use the chart, find the key number of the steel at the left. Suppose the steel is SAE 3120 and its hardness is 25 Rockwell C. Its key number is 9. Read down the key column (boldface numbers) to 9. Follow the line to the right where it intersects the proper hardness curve, in this case Rockwell C 21-27. From this intersection drop a line to the scale for surface feet. The best finishing speed is read as about 550 fpm.

SAE No.	Key	SAE No.	Key	SAE No.	Key	SAE No.	Key
1010	4	x1345	8	3230	11	4615	11
1015	4	x1350	9	3240	12	4620	11
1020	4	2105	7	3245	12	4640	12
1030	6	2115	7	3250	12	4650	12
1035	7	2315	7	3312	11	4815	11
1040	8	2320	10	3325	11	4820	11
1045	9	2330	11	3330	11	5120	10
1050	10	2335	11	3335	12	5130	10
1060	11	2340	11	3340	12	5140	11
1095	12	2345	11	3415	10	5150	11
1112	1	2350	11	3430	12	6115	9
x1112	1	2512	10	3435	12	6120	10
1115	2	2515	11	3450	12	6125	11
1120	2	3115	8	4115	8	6130	11
x1314	3	3120	9	4130	10	6135	11
x1315	3	3125	10	x4130	10	6140	11
x1330	5	3130	10	4135	12	6145	12
x1335	7	3140	11	4140	12	6150	12
x1330	7	x3140	11	4150	12	30905	12
x1335	8	3145	11	4340	12	51210	9
x1340	8	3150	11	4345	12		



Relation of Tool Radius and Lead to Surface Finish (Nonferrous Metals)





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(Keene co-chapter .....109)
Wichita 111
Worcester 110

Dr. Harry B. Osborn, Jr., national officer of the American Society of Tool Engineers, congratulates Chairman Joe Duncanson on the chartering of the new Nebraska chapter. The organization became the 103rd chapter of the Society at ceremonies held February 19 at the American Legion Club in Omaha.

ASTE Charters Nebraska and Memphis Chapters

Membership in the American Society of Tool Engineers hit a new high when two new chapters were chartered in February. The most recent additions to the ever-growing roster of ASTE are the Nebraska chapter, number 103, and the Memphis chapter, number 105. Total membership in the Society now stands at more than 25,000.

Although chartered in January, the Louis Joliet chapter in Joliet, Ill., was designated as chapter 104 because its charter application was received at national headquarters after that of the Nebraska chapter, number 103.

Chartering ceremonies for the Nebraska ASTE chapter were held February 19 at the American Legion Club in Omaha. Dr. Harry B. Osborn, Jr., a national director and officer of the Society, swore in the officers and presented the charter to Joe Duncanson, chapter chairman. Other officers of the chapter are: Sam Grasso, first vice chairman; Seb Circo, second vice chairman; Herbert Bro, secretary; and Elmer Larson, treasurer.

The technical speaker was Adam Gabriel, president of the Acme Industrial Co. of Chicago. He presented a program on "Micro Precision in Production." Marvin Bunting of ASTE national headquarters gave a brief talk on the Society and presented the membership kit to Ronald Pierce, chapter membership chairman.

On the following evening, February 20, members of the Memphis chapter were officially welcomed into the Society. The charter meeting was held at the Hotel King Cotton.

H. E. Collins, national secretary for 1952-53, presented the charter and administered the oath to the chapter officers. They are: A. T. Hicks, chairman; Roy Small, first vice chairman; E. T. Crofoot, second vice chairman; William Branch, secretary; Leslie Lance, treasurer; Mr. Hicks, delegate; and R. McIntyre, alternate delegate.

The chairman's pin was presented by C. T. Burke of ASTE national headquarters. The meeting was then turned over to Chairman Hicks who conducted a general discussion period.

H. E. Collins, left, a national officer of the American Society of Tool Engineers, swears in the charter officers of the Memphis chapter at the first official meeting held February 20 at the Hotel King Cotton. Pictured, from left, are: A. T. Hicks, chairman; Roy Small, first vice chairman; William Branch, secretary; Leslie Lance, treasurer.

Heads are bowed for the benediction given by Dr. W. M. Logan. The lower photo shows some of the estimated 150 persons present for the dedication.

A box containing ASTE articles of incorporation is put in place by W. B. Peirce as W. H. Smila and L. B. Bellamy watch.

Another ASTE 'First':

1953 Leadership Conference

Because of its great interest to members of ASTE, up-to-the-minute news of the Leadership Conference is published by THE TOOL ENGINEER *in this special four-page report.*

From every one of ASTE's 105 chapters in the United States and Canada, newly-elected chapter chairmen came to Detroit on March 16 to help dedicate the ASTE national headquarters building and to make the only Leadership Conference ever presented by a technical society a resounding success.

The two-day event was launched with a welcome breakfast and featured a tour of the Society headquarters, speeches by ASTE past presidents, national officers and committee chairmen, discussion sessions, receptions and banquets, and two dramatic presentations by the national headquarters staff.

For the dedication ceremonies, a special platform with a bright blue canopy was constructed outside the main entrance of the ASTE building. Chartered buses brought the chairmen from the Statler Hotel in record time with the aide of a police escort. Enthusiasm of all those present helped to warm the cold and blustery March day turned out by the Michigan weatherman.

Past President Smila, top photograph, makes the dedication address. Ushers Betty Silarski and Jacqueline Rupert, lower photo, greet two chapter chairmen.

Waindle Elected National President

At the 1953 election of officers, Roger F. Waindle was named president of the American Society of Tool Engineers. Other officers are: Joseph P. Crosby, first vice president; Dr. Harry B. Osborn, Jr., second vice president; Howard C. McMillen, third vice president; Raymond C. W. Peterson, secretary; Harold E. Collins, treasurer; Wayne Ewing, assistant secretary-treasurer; Harry E. Conrad, executive secretary; and Allen Ray Putnam, assistant executive secretary.

Dorothy Taylor, assistant editor of The Tool Engineer, guides a group of chapter chairmen through the national headquarters building.

Tours took visitors through every part of the ASTE building, including the offices of the magazine. Shown here, from left: Theresa McMahon, Marian McGraw, Joann Pozniak, Emma Wendt, Loretta Bourgeois and Geraldine Needham. The open house followed the dedication ceremonies.

News Photographs by Lens-Art

Chairman of the dedication program was Leslie B. Bellamy, 1952-53 president of ASTE. The laying of the plaque was done by Past President W. B. Peirce. William S. Smila, also a past president, delivered the major address. Dedication prayers were given by three representatives of the Detroit clergy.

After the tour of the building, activities turned to the Engineering Society of Detroit for a conference luncheon and an address by Past President A. M. Sargent. National officers and committee chairmen discussed their responsibilities and

Left: William Cameron, far right, gives last-minute stage directions to: Robert Kimmel, Edythe Reichart, Richard Bacik, Harry Anderson, Archie Knight and C. T. Burke. Past President C. V. Briner, shown with microphone, made the major address at the banquet.

Allan Ray Putnam was the narrator for the play "Sauce for the Gander" which was produced for the Leadership Conference.

Harry E. Conrad, cast in the role of the president of the Gearville Gear Co., scans photographs taken at dress rehearsal with Dean Coffin, Detroit writer and director, and Nancy L. Morgan who played the part of the chapter chairman's wife in the production.

staff personnel outlined national headquarters operations. The official program for "National Day" was concluded with a conference dinner and a talk by Kenneth A. Meade of General Motors Corp. and president of the Engineering Society of Detroit.

"Chapter Day" turned the program emphasis from national activities to those at the chapter level. Talks were made on many topics, including standards, membership, finance, public relations, constitution and by-laws, and professional engineering. Discussion groups met to cover informally many of the current questions confronting ASTE chapters.

Conference delegates proved to be the grandest drama critics alive when ASTE staff members gave the first performance of the play "Sauce for the Gander" written especially for the occasion by playwrite Dean Coffin.

The Officers and Directors Reception and the Leadership Banquet provided a fitting close for the conference which marked another milestone in ASTE history. The banquet address was delivered by Past President C. V. Briner and President Bellamy administered the chairman's oath of office.

Congratulations are in order at a chapter meeting in the play. From left: Frank Wilson, C. T. Burke, Jack Holt, Jerry Harrington, Marvin Bunting, Archie Knight, Ralph Eshelman and Richard Bacik.

Lower left photograph: Jerry Harrington tells the merits of ASTE membership to his boss Mr. Lorimer in a tense scene from "Sauce for the Gander." The curtain call shows the cast receiving the applause of an appreciative audience. Grant Wilcox, far right, introduced the play with a take-off on Ted Lewis.

ASTE Leadership Conference, March 16-17, 1953

Detroit, Michigan

Front row, from left: L. B. Bellamy, sitting in for Michael Pinto, Detroit; Wallace E. Swan, Racine; Gordon W. Carlton, Cleveland; Eugene J. Anspach, Milwaukee; Harry A. Paine, Chicago; Richard W. Smith, Fairfield County; Omer A. Gingras, Hartford; Lawrence J. Brozek, Pittsburgh; Joseph Kertz, Toledo; William J. Iekel, Buffalo-Niagara Frontier; Carl E. Fasth, Twin Cities; William Moreland, Rockford; Donald E. Wernz, Baltimore; William E. Wheaton, Northern New Jersey; Campbell R. Pittsinger, Philadelphia; Donald F. Kohler, Rochester; Willis J. Potthoff, St. Louis; Richard A. Miller, Dayton; Robert D. Fulford, Syracuse; George S. Nelson, Schenectady; Richard B. Niebusch, Cincinnati; Raymond Meckley, Central Pennsylvania; Gilbert H. Jording, Tri-Cities; Charles Roe, Elmira; John E. Rotchford, Worcester; David R. Few, Toronto; and Carl L. Almquist, Los Angeles. Second row: David A. Gustafson, Golden Gate; Otis Traughber, Houston; James L. Kemp, South Bend; Raymond J. Zimmerman, Peoria; Robert M. Dickson, Springfield, Mass.; Wilfred B. Wells, Boston; Hartley W. Barclay, Greater New York; Howard Bertholf, Binghamton; Emmett A. Bartlow, Columbus; Joe Penn, Indianapolis; Roy A. Coady, Seattle; George Julien, Twin States; Emanuel E. Lull, New Haven; Clarence E. Bulmer, Hamilton District; Warren A. Thornberry, Nashville; Arthur E. Crom, San Diego; Erwin J. Kaiser, Fond du Lac; John Green, Portland, Me.; Frank A. Flannery, Akron; George M. Beck, Potomac; William J. McCoy, Williamsport; Charles A. Gareau, Montreal; Jimmie E. Franklin, North Texas; A. A. Reddy, Wichita; Fred W. Kunath, Little Rhody; and George H. Wilhelm, Louisville. Third row: John F. Johnson, Windsor; Donald D. Welbaum, Fort Wayne; Merlin R. Grundy, Kansas City; Arnold G. Luther, Decatur; Lawrence C. McKinley, New Orleans; Charles D. Toney, Jr., Atlanta; Harry M. Rudd, Erie; Melvin S. Nielsen, Portland, Ore.; Earl J. Kane, Springfield, Ill.; Albert Clarkson, Niagara District; Russell H. Culbertson, Richmond, Ind.; Chester W. Vermilyea, Phoenix; Donald A. McMillen, Saginaw Valley; Carl A. Darger, Muncie; Richard L. Coyner, Cedar Rapids; Philip Shaner, Fox River Valley; Paul W. Vierling, Evansville; Stanley P. Cook, Mid-Hudson; Larry Ellis, Madison; Richard Montanus, Springfield, O.; Clinton J. Helton, Denver; Earl K. Wheat, Mohawk Valley; and Frank La Mar, Des Moines. Fourth row: John F. Ward, Hamilton District; Edward N. Dietler, Piedmont; Carlyle F. Blanchard, Long Beach; Prof. Frederick Preator, Salt Lake City; Jacob J. Repetto, Granite State; Robert Pioch, Jackson; Arthur Cervenka, Long Island; Raymond Moorhead, Greater Lancaster; Lester W. Williams, Tulsa; Louis Jensen, London-St. Thomas District; Frank J. Elliott, Los Alamos; Harold Baecker, Albuquerque; Leendert Hansler, Peterborough; Peter Carter, San Gabriel Valley; Edward J. Giroux, La Crosse; A. E. Feightner, Lima; William C. Lanyon, Santa Clara Valley; Rudolph Regen, San Fernando Valley; Glen H. Stimson, North Central Massachusetts; Jack Lipman, Keystone; Charles Bazaz, Paterson; Joe A. Duncanson, Nebraska; Harry Moffat, Joliet; A. T. Hicks, and James D. Reach, Tucson.

Grant Wilcox Named Plymouth Coordinator

Grant S. Wilcox, a past national director of ASTE and a member of the Detroit chapter, has been appointed coordinator of special program development at the Plymouth Division of the Chrysler Corp., according to an announcement made by J. P. Mansfield, president of the Plymouth Division.

A graduate of the University of Michigan and Antioch College, Mr. Wilcox is a Registered Professional Engineer. He began his automotive career with Plymouth in 1936 and served in such supervisory capacities as tool test engineer, tool engineer, tool stores supervisor, chief tool engineer, assistant master mechanic and assistant factory manager. In 1951 he was promoted to the staff of special products planning and later that year appointed to the staff on subsidiary operations.

Mr. Wilcox has served the Detroit chapter of ASTE as editorial chairman, vice chairman and chapter chairman. He has headed the data sheet subcommittee for the National Standards Committee of the Society since 1945 and served on the Housing Committee for the ASTE headquarters building. A charter member of the Engineering Society of Detroit, Mr. Wilcox was president in 1950-51 and has been a member of the board of directors since 1947. He has also served as second vice president and secretary of ESD and as chairman of the Affiliate Council.

Grant S. Wilcox

Demuth Returns to Production Post in Washington

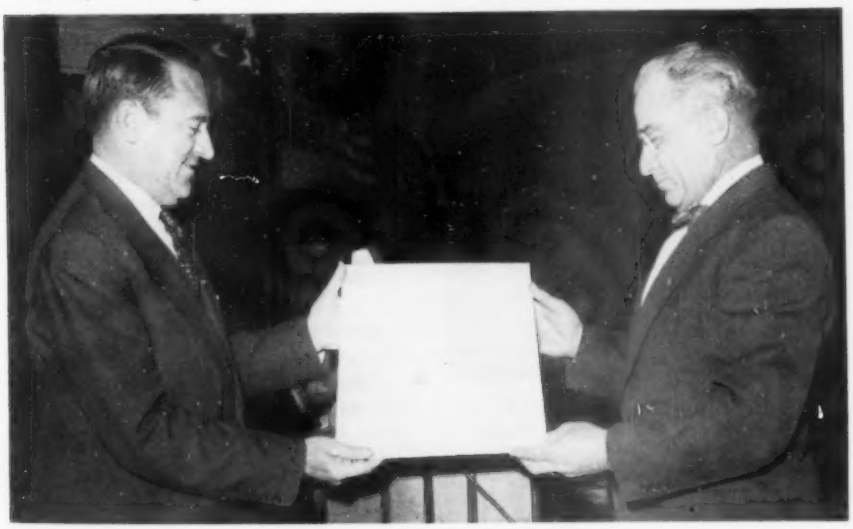
J. J. Demuth, engineering consultant for Ehrhardt Tool & Machine Co., St. Louis, and past president of the ASTE, has been named consultant to the Tool, Die, Jig and Fixture Section, Metalworking Equipment Division, National Production Authority, Washington. He will devote three days a week to his new duties.

Mr. Demuth was recently given a testimonial award by the National Tool & Die Manufacturers Association for his previous service as chief of this important section of NPA. His extensive knowledge of the tool and die industry will again be utilized by NPA in coordinating tool and die production with the national defense program.

Mr. Demuth replaces Ross Adams, who has served in a similar capacity for NPA during the past six months and is now associated with The Fellows Gear Shaper Co., Springfield, Vt.

Mr. Demuth's Washington telephone number is STerling 3-5200, Extension 4814.

Daniel Koplick, left, presents award to J. J. Demuth, past president of ASTE, for his previous service with the National Production Authority.



Purdue University, ASTE Sponsoring April Meeting

A panel discusion on "Machining Hard-to-Machine Materials," reports of special research on grinding of geometric sections and a tour of the new million-dollar machine tool laboratory of Purdue University at Lafayette, Indiana, will feature the Tool Engineering Conference, sponsored April 18 by Indiana chapters of the ASTE. The one-day technical conference, planned for 1,000 members of the Evansville, Fort Wayne, Indianapolis, Muncie, Richmond, and South Bend chapters, is in line with the national education program of the Society.

Speaker for the noon luncheon and toastmaster for the evening dinner will be Roger F. Waindle, a national officer of ASTE.

Processes to be discussed by the panel will include electro-mechanical (arc) machining, electrolytic grinding, ultrasonic machining and electro-spark machining. Panel members will be M. F. Judkins, chief engineer, High Temperatures Alloys Div. of Firth-Sterling Steel and Carbide Corp., Pittsburgh; L. H. Metzger, president of Super-Cut Corp., Chicago; W. L. Hardy, grinding engineer, The Norton Co., Worcester, Mass.; Arthur Kuris, president of Cavitron Equipment Co., New York City; and H. V. Harding, chief engineer, Elox Corp., Clawson, Mich.

H. L. Newport, instructor in manufacturing processes at Purdue, will report on results of his special research in "Grinding of Geometric Sections." He will discuss methods and machines for producing externally ground shapes of other than circular cross sections, such as squares, ovals, triangles and elipses, and the application of such shapes to product design.

Vice president F. C. Hockema of Purdue, will be the speaker for the dinner meeting which will wind up the all-day session. Purdue president Frederick L. Hovde will welcome the guests at the noon luncheon. H. F. Owen, professor of mechanical processing, is general chairman of the conference.

A. M. Sargent Opens New Office in Detroit

A. M. "Al" Sargent, founder and former president of the Pioneer Engineering and Mfg. Co., who recently resigned his interest in that firm, announced he has opened his own consulting engineering office at 10120 West McNichols Road, Detroit 21.

Sargent, a former national president and one of the founders of ASTE, has more than 40 years of industrial experience in every phase of manufacturing from product design to cost control.

Saginaw Valley; Carl A. Darger, Muncie; Richard

Tool Engineering Day Scheduled for April 14

Under the sponsorship of six chapters of ASTE, the first Tool Engineering Day will be observed in New York City on April 14. Members of the Greater New York, Long Island, Northern New Jersey, Paterson, Mid-Hudson and Fairfield County ASTE chapters will meet with industrial leaders at the Hotel New Yorker for a banquet honoring two of the nation's most outstanding executives.

They are Harold S. Vance, chairman of the board and president of Studebaker Corp., South Bend, Ind., and consultant to the office of defense mobilization, and Lt. Gen. K. B. Wolfe (Ret.) president of Oerlikon Tool & Arms Corp. of America, Asheville, N. C.

Mr. Vance, as chairman of a special committee on the nation's defense, recently reported on the production facilities required for defense organizations during the next ten years. He is presently a consultant to defense officials and is serving as a vice president of the Automobile Manufacturers' Association.

Gen. Wolfe was commanding general of the 20th Bomber Command at the time it made its first B-29 raid on Japan. He has also served as head of the Fifth Air Force, and of Procurement Industrial Planning for the Air Materiel Command.

The master of ceremonies will be Joseph E. Ridder, publisher of the New York Journal of Commerce, chairman of the board of American Bosch Corp., Springfield, Mass., and of Arma Corp., Garden City, L. I.

Harold S. Vance

Boston ASTE Chapter Elects 1953-54 Officers

Boston—New officers of the Boston ASTE chapter, elected at the February meeting, are: Wilfred B. Wells, chairman; Karl G. Nowak, first vice chairman; Walter Pohle, second vice chairman; Thomas B. Walsh, secretary; Robert H. Marsh, treasurer; Mr. Wells, delegate; J. X. Ryneska, alternate; and C. W. Christianson, ESNE councillor.

The technical session was presented by George R. Morin, chief sales engineer, Jones and Lamson Machine Co., Springfield, Vt. He discussed the newly established feed and speed standards resulting from the engineered use of cemented carbide tools. Olaf O. Peterson introduced the speaker.

A special film feature on the making and shaping of steel concluded the meeting. —*Harry Midgley*

Executives Present New York Program

New York City—Rene D. Wasserman, president of the Eutectic Welding Alloys Corp., Flushing, N. Y., and C. E. Ivins, Jr., assistant to the vice president at Keuffel Esser Co., Hoboken, N. J., were the featured speakers at the February meeting of the Greater New York ASTE chapter.

Mr. Ivins spoke about the characteristics and general application of glass cloth in industry. He traced its use in the aircraft industry and outlined its ever-increasing acceptance for producing engineering drawings, grids, and templates on sheet metal, form blocks, die blocks and tool stock.

In his discussion, Mr. Wasserman explained how welding was opening new fields in the maintenance and design of machine tools. Examples were given, from actual case histories, where the new chamfering and cutting electrodes have supplanted the lengthy grinding and milling operations. Conventional designs changed to all welding assemblies have simplified casting, saved metal, reduced weight, and cut labor costs.

Mr. Wasserman emphasized the impact of salvage operations upon the defense effort. Replacement orders are diminishing at a speed in direct ratio to the reduction of the scrap heap. Tools and dies are being salvaged at a fraction of the cost of replacement and a comprehensive maintenance program is being established by many firms.

—*Robert Frechman*

ASTE Contributes to Detroit Building Fund

Harry E. Conrad, executive secretary of the American Society of Tool Engineers, and A. M. Sargent, a past president of the ASTE and one of its founders, presented a $1,000 check to Acting Mayor Louis Miriani and City Treasurer Charles N. Williams, contributed by the ASTE to the building fund for the new convention hall and exhibit building.

The Society, the only major national technical society to maintain its headquarters in Detroit, hopes to schedule its 1956 industrial exposition for the new structure.

Mr. Sargent, Detroit industrial consulting engineer, is a member of the Citizens Advisory Committee for the Civic Center, and planned the ultramodern design of the building which has won the approval of city officials.

City Treasurer Williams' office said the $1,000 contribution raises the total contributions received for the convention hall and exhibit building to approximately $5,350,000 of the $7,000,000 to be subscribed by citizens and industry.

The building fund for a new Detroit Convention Hall got a boost when Harry E. Conrad, left, ASTE executive secretary, and A. M. Sargent, right, past president of the Society, presented a $1,000 check from the American Society of Tool Engineers to Acting Mayor Louis Mariani, second from left, and City Treasurer Charles N. Williams. Contributions to the fund from citizens and industry now stand at $5,350,000.

An all-day area conference was held February 21 at the Royal York Hotel in Toronto for officers of the Canadian chapters of ASTE. Meeting with them were Gerald A. Rogers, a national officer, and Allan Ray Putnam, assistant executive secretary of the Society. Seated, from left, are: John Snyder, Hamilton District; Charles Gareau, Montreal; Mr. Putnam; David Few, Toronto; Mr. Rogers; and William Shaw, Hamilton District. Standing: C. J. McDowell, Montreal; Douglas Cooper, Toronto; Albert H. Ward, London-St. Thomas; Cyril Mitchell, Niagara District; Albert H. Clarkson, Niagara District; David Heath, Windsor; David E. McCready and John Ward, Grand River Valley; and Eric Browne, Toronto.

Evansville Members Tour Bernardin Bottle Cap Co.

Evansville, Ind.—February activities of the Evansville ASTE chapter included the annual election of officers and a plant tour of the Bernardin Bottle Cap Co.

New officers selected are: Paul W. Vierling, chairman; Arthur A. Ullman, first vice chairman; John A. Race, second vice chairman; Carl Doughty, secretary; Russell H. Wiberg, treasurer; and Henry J. Pernicka, delegate.

The dinner meeting, held at the Hadi Shrine Temple, was attended by 101 members and guests. The business session was followed by the plant visitation. *—Russell H. Wiberg*

William Carr Presents South Bend Program

South Bend—Interplanetary flights and rocket trips to the moon were discussed at the February technical session held by the South Bend ASTE chapter at the Izaak Walton League Club House.

Guest speaker was William F. Carr, engineer with Lear, Inc. of Grand Rapids, who drew on his wide experience in working with guided missiles, automatic pilots and other related subjects. He said that a good many scientists feel that space travel may very well arrive in the next forty or fifty years.

The officers selected by the nominating committee were elected unanimously by the chapter membership. James L. Kemp is chairman; Harold Housewerth, first vice chairman; John Berker, second vice chairman; E. J. Nelson, secretary; and Walter Prohaska, treasurer. *—E. J. Nelson*

Positions Available

SENIOR STRUCTURES AND DESIGN ENGINEERS—If you would like to play an important part in the long-range program for the development of practical designs for large forging and extrusions to be produced on the United States Air Force's new heavy presses, the Harvey Machine Co., Inc. will be pleased to consider your inquiry.

Your job would be to work with aircraft engineers in the early design stages and assist them in securing the maximum economies in design.

You will have an excellent opportunity to promote sound design principles and to anticipate and plan for future design trends in many military and commercial fields.

You should have a B.S. or M.E. degree, and at least eight years' diversified experience in airframe design and structure. Send a brief resume of your experience and background to the Harvey Machine Co., Inc., 19200 So. Western Ave., Torrance, California.

William Carson Addresses Election Night Meeting

Oakland, Calif.—Nearly 100 members and guests of the Golden Gate chapter were on hand for the election meeting held February 18 at Bellini's Restaurant. William M. Carson, industrial representative for the Carborundum Co., presented a lecture and movie on "Romance in Industry."

With David A. Gustafson as chairman, the following men were elected to chapter offices: L. Dean Rouland, first vice chairman; Vern Gallichotte, second vice chairman; Ted N. Lindquist, secretary; and Raymond G. Reed, treasurer. *—T. N. Lindquist*

Crosby Addresses Twin States Chapter

Claremont, N. H.—Coffee speaker at the February 11 meeting of the Twin States chapter was Joseph P. Crosby, second vice president of ASTE, who discussed the Society's first Leadership Conference. The dinner session was held at the Hotel Moody and attended by more than 130 members and guests.

A number of new members were introduced by Harold Noyes, Twin States membership chairman, and presented with membership pins by Robert Gay, area captain of the National Membership Committee. Recipients were: Louis Helmich, Robert Hamilton, Robert Wyman, Arnold Cutting, Charles Murray, Raoul Pitre, Russell Bean, Proctor M. Lovell, Philip Durland, Arthur Taylor, Harry McIntosh, and Hermann Kreissles of the Keene co-chapter.

Technical speaker was Louis G. Helmick, works manager, Joy Mfg. Co., Claremont, N. H., who described methods and equipment required in coal and metal mining. He showed a color film on hard rock mining which pictured the mining of salt, iron, coal and limestone. Various types of shuttle cars, loading machines, and mobile cutters were shown in actual operation. A plant tour of the Joy Co. followed the meeting. *—Stacey C. Farrell*

Klonowski Discusses Punch Failure

Atlanta—Meeting at Peacock Alley on February 16, about 50 Atlanta ASTE members elected new chapter officers and heard an address by Edmund J. Klonowski, sales manager, Punch Div., Pivot Punch and Die Corp., North Tonawanda, N. Y.

His discussion topic was "Pivot Punches—Their Use and Application." He pointed out the importance of proper punch design if a working tool of high productivity and long life is expected.

Outlining the reasons for early punch failure, Mr. Klonowski said they usually fail from flexure attending operation where misaligment and other conditions of improper tooling details prevail. Abnormal flexure stresses have a propensity to concentrate at changes in section, scratch marks, and other imperfections which cause notch effect and which ultimately lead to punch breakage. *—Joe L. Morris*

Walter Alvin Promoted

Walter Alvin, member of the Boston ASTE chapter, has been promoted to plant superintendent of the Cummings Machine Works in Boston. He formerly held the position of tool designer.

New Officers Named by Granite State Chapter

Exeter, N. H.—About 40 members and guests attended the February 10 meeting of the Granite State chapter held at the Exeter Inn. After dinner, the following men were elected to guide ASTE activities during the next year; J. J. Repetto, chairman; H. Smith, first vice chairman; J. L. Rousseau, second vice chairman; George Chapman, secretary; and Gino Magnani, treasurer.

The technical program, presented by Warren D. Getchell of the McCrosky Tool Corp., Meadville, Pa., was devoted to a discussion on "The Overall Economics of Metal-Cutting as Applied to Milling."

Mr. Getchell covered milling production rates, tool costs, cutter maintenance, tools for small lot and full production, selection of suitable tool material for different operations, machine conditions, cutter designs, speeds and feeds, grinding and resharpening, and applications of milling from an economic standpoint. A sound film on carbide milling and sharpening carbide cutters supplemented the lecture. —*J. L. Rousseau*

Lehigh Valley Members Elect John D. Folwell

Allentown, Pa.—Officers of the Lehigh Valley ASTE chapter were elected at the February 20 meeting held at the Hotel Traylor. John D. Folwell was named chairman; Werner O. Miller, first vice chairman; William Schiebel, second vice chairman; Vincent Scalese, secretary; and Ralph L. Mueller, treasurer.

The technical program was presented by A. E. Glen, manager of die sales, Carboloy Dept., General Electric Co., Detroit. His subject was "The Use of Tungsten Carbide Dies in Industry Today." —*John D. Folwell*

W. J. Kuhn, left, Giddings and Lewis Machine Tool Co., spoke on boring tools at the February meeting of the Chicago chapter. Harry Paine, right, is the new chairman.

Tri-Cities Plant Tour Draws Large Attendance

East Moline, Ill.—A large attendance of 215 persons was on hand for the February 11 meeting of the Tri-Cities ASTE chapter. New officers were elected and the chapter participated in a plant tour of the American Machine & Metals Co.

Gilbert Jording was named chapter chairman, Robert E. Cannon, first vice chairman; Maurice J. Ullman, second vice chairman; Rayburn M. Knabe, secretary; and Dan McKeon, treasurer.

The evening's activities began with dinner at the American Legion Club. Mr. Cannon presided and introduced R. M. Hammes, assistant to the general manager of the East Moline Div. of American Machine. After welcoming the chapter, Mr. Hammes gave a brief resume of the various products manufactured by his company.

The tour included every department of the plant which turns out testing machines, exhaust fans, precision instruments and equipment for commercial laundry machines.

—*Melvin Winterlin*

Chicago Chapter Names New Officers

Chicago—Harry Paine was elected chairman of the Chicago ASTE chapter at the February 2 meeting held at the Keyman's Club. More than 150 members attended the session. Other men named to serve for the coming year are: John Beck, first vice chairman; O. J. Onken, second vice chairman; Alvin Winkler, secretary; and Joe Kayda, treasurer. Trustees of the Marshall Blu scholarship fund are: Gordon Benes, Frank Martindell and Tom Barber.

Technical speaker for the program was M. J. Kuhn, midwestern sales engineer, Davis Boring Tool Div., Giddings and Lewis Machine Tool Co., Fond du Lac, Wis. He was introduced by Harry Conn.

Mr. Kuhn discussed block type boring tools. The main advantages of the boring blocks are their interchangeability, ease of insertion and removal. The blocks can be ground in the bars since the bars have centers and can be allowed to float by backing off the centralizing screws. The bars and tools required for rough and finish boring a valve body were shown. Diameters were held to 0.005 inch in one pass and 0.001 inch in two passes.

A movie picturing the application of block type boring tools to numerous jobs supplemented the lecture.

—*A. L. Winkler*

Birgbauer Heads Cutting Tool Assoc.

Gorden Birgbauer, president of the Super Tool Co., Detroit, was elected president of the Cutting Tool Manufacturers Assoc. at the annual meeting held in Detroit.

Robert H. Wolfe of the Arrow Tool and Reamer Co. was elected vice president and R. S. Spencer of the Detroit Boring Bar Co. was elected treasurer.

Past chairmen of the Fort Wayne chapter helped to celebrate the tenth anniversary of receiving the ASTE charter at a special meeting held in February. From left: Everett Keese, Ralph Didier, La Mar Brant, John Davis, Leonard Roebel, Emil Mellin, John Astrom, Milton Kline, Paul Weitzman, and Cyril Grinrod.

Long Beach members welcomed L. B. Bellamy at their February meeting. Pictured with him in the top photo, from left, are: John Stansbury, Ben Hazewinkel, Mr. Bellamy, and Frank Wallace.
Left: Chuck Ward receives honor award for service to the Long Beach chapter from Mr. Wallace.

Indianapolis Members Elect Joe Penn Chairman

Indianapolis—Joe Penn was named chairman of the Indianapolis chapter at the election-meeting held February 5. Well over 100 members and guests were present for the balloting. Other officers who will be guiding ASTE chapter activities in Indianapolis are: Joseph Enright, first vice chairman; Ted Harding, second vice chairman; Lloyd Refer, secretary; Lloyd Turner, treasurer; Denis White, delegate; Mr. Penn, alternate; and Clarence Wetzel, second alternate.

The technical program was presented by James B. Price, assisted by Fred Dischinger and Ralph Dunn, all of Haynes Stellite Co. Their subject was precision investment castings.

Mr. Price pointed out the advantages of casting parts to their finished dimensions with little or no finish work necessary. As in the case of one small sewing machine part, the part was used as it came from the mold with no finish work necessary, saving 80 percent of the former cost.

A brief talk was made by Jack Hofeld of the Indianapolis Engineer's Club who encouraged members of ASTE to join his organization. *—Joe Penn*

Bellamy Urges More Active ASTE Participation

Long Beach—National ASTE President L. B. Bellamy was an honored guest at the February 12 meeting of the Long Beach chapter. He spoke to the group on "The Impact of Tool Engineering on Modern Economy," stressing the importance of each ASTE member participating actively in his chapter to get the most out of his membership.

New officers elected at the meeting are: Carl Blanchard, chairman; Carol Edson, first vice chairman; Vincent Kerns, second vice chairman; Larry Pomerantz, secretary; LeRoy Hutchison, treasurer; Frank Wallace, delegate; and John Stansbury, alternate delegate.

The technical program was presented by Vince Buerge of Wesson Carbide Co., who showed a film on the production and use of tungsten carbide in modern industry. The movie proved to be a concrete illustration of one of Mr. Bellamy's major points—"Tool Engineering makes it possible to make the best use of the technical developments of the day."

—William C. Irby

Fort Wayne Observes Tenth Anniversary

Fort Wayne—Past chairmen of the Fort Wayne ASTE chapter were honored at the tenth anniversary meeting held February 11 at the Chamber of Commerce Building. Each one present spoke briefly to the chapter on the highlights of his term of office.

Several talented entertainers presented a program for the 60 members and guests participating in the event.

—Richard Spaw

New Haven Past Chairmen Attend February Meeting

New Haven—A number of past chairmen were present for the February dinner meeting of the New Haven chapter held at the Hotel Garde. They were: Gus Weldon, Al Pollard, Fred Dawless, Frank Shute, Dave Mathewson, and Ray Gifford. The evening's program included a technical session and the annual election of officers.

A unanimous vote was cast for the slate presented by the nominating committee. Guiding New Haven activities for the next year are: Emanuel Lull, chairman; John Brozek, first vice chairman; Charlton Gilbert, second vice chairman; Stanley Porritt, secretary; George Griffith, treasurer; Mr. Lull, delegate; and Joe Benson, alternate delegate.

The guest speaker was Charles P. McShane, metallurgical engineer with the Cruicible Steel Co. He spoke on the topic "The Effect of Molybdenum in Tool and High-Speed Tool."

Education Chairman Russell Applegate announced a lecture series offered in March at the Mason Mechanical Engineering Laboratory. Subjects discussed included: "Selection and Heat Treatment of Tool Steel" by J. Y. Reidel, tool steel engineer, Bethlehem Steel Co.; "Metallurgical Aids to Better Grinding" by Dr. Leo P. Farasov, research and development engineer, Norton Co.; and "Machinability of Steels" by Maur J. Weldon, metallurgist, Henry G. Thompson & Son Co.

—Silas W. Becroft

Keene ASTE Members Hear Talk on Castings

Keene, N. H.—The Keene affiliate of the Twin States ASTE chapter held its January meeting at the Eagle Hotel. William Shuman, manager of the quotations division, and Edward Broad, metallurgist, Hitchiner Mfg. Co., Milford, N. H., were the technical speakers.

Mr. Shuman discussed the procedure in producing investment castings or precision castings, from the machining of the steel die to produce the wax or plastic model of the part involved, to the necessary finishing operations. He illustrated his talk with samples of dies, wax models, parts of molds and finished pieces.

Mr. Broad spoke on problems involved in precision casting and factors which influence the physical properties and the inability to meet some specifications of these physical properties.

The meeting was conducted by Charles Hanrahan, chairman of the group, who presented pins to several new members. *—Philip H. McKinstry*

Baltimore Members Elect Donald Wernz

Baltimore—At the annual election meeting held February 9 by the Baltimore chapter, Donald Wernz was named ASTE chairman for the coming year. Other members named to office were: Joseph Antonelli, first vice chairman; Richard Coleman, second vice chairman; LeRoy Rubright, secretary; Herbert Middlestadt, treasurer; Leon Laux, delegate; and Mr. Wernz, alternate delegate.

The dinner program, attended by more than 125 members and guests, included a coffee talk by Richard L. Steiner, director of the Baltimore Redevelopment Commission, who discussed new building and slum clearance in Baltimore.

"New Developments in Coated Abrasives" was the subject of a talk made by E. E. Oathout, products and equipment engineer, Behr-Manning Corp., Troy, N. Y. —*Leroy L. Rubright*

Houston Officers Chosen at February 10 Meeting

Houston—About 110 members and guests of the Houston ASTE chapter were present for the February dinner meeting held at the Ben Milam Hotel. A featured event of the evening was the annual election of officers.

Guiding chapter activities during 1953-54 are: H. O. Traughber, chairman; H. G. Boswell, first vice chairman; J. W. Hindman, Jr., second vice chairman; J. D. Bailleres, secretary; and Paul Langdale, treasurer.

The technical talk presented that evening was on the topic "In and Outside the Grinding Wheel." Speaker was Robert C. Fisher, manager of the Engineering Service Dept., Products Div., Cincinnati Milling and Grinding Machines, Inc. —*C. K. Hay*

The high school winners of the first semester contest in mechanical drawing sponsored by the Rockford chapter were entertained at a plant tour of the Fairbanks-Morse Co. in Beloit, Wis. At the back: H. C. Maitland, head of industrial arts department at East High School; Walter Lewis, chapter education chairman; and Bruce Lundgren, chapter chairman. In front: Kay Strites, Kenneth Backman, Alan Riddiford, Dennis Folkerts, Ronald Hirth, and Emery Lloyd.

Monosmith Discusses Die Block Milling

Dayton—The technical program for the February 9 meeting of the Dayton chapter was sponsored by Sundstrand Machine Tool Co. The firm's director of physical research, L. B. Monosmith, presented a discussion on die block milling and Frank Suchanek spoke on magnetic holding devices.

The dinner meeting, held at Suttmiller's Restaurant, was attended by 140 members and their guests. One of the highlights was the annual election of officers. With Richard Miller as chairman, the following men were chosen to serve for the coming year: Roy Dusseau, first vice chairman; Vic Bohl, second vice chairman; Francis Eberling, secretary; and Warren Brown, treasurer. Richard Blair was named delegate and Mr. Miller alternate.

On January 12 about 50 members drove to Troy, Ohio, for a plant visitation at Hobart Brothers Co.

—*W. J. Killinger*

Positions Available

TOOL AND MACHINE DESIGNERS —One of Cincinnati's largest permanent design firms has openings in their own office for experienced machine, product and tool designers, and detailers.

Recent engineering graduates or students will also be given consideration. These are permanent positions with a substantial, stable leader in the field. We can offer top starting wages, modern working conditions, paid holidays, vacations, and other benefits. Our policies assure varied experience and unusual opportunities with a future.

New employees would be expected to settle on a permanent basis in Cincinnati. Please send resume to Cincinnati Designing, Inc., 8120 Blue Ash Ave., Cincinnati 36, Ohio.

The technical program at the February meeting of the Dayton chapter was presented by Frank Suchanek, second from left, and L. B. Monosmith, third from left, of the Sundstrand Machine Tool Co. Shown with the speakers are R. A. Miller, left, newly elected chapter chairman, and R. M. Blair, chapter delegate.

Elect John Rotchford Worcester Chairman

Harry S. Conn, chief engineer, Scully-Jones & Co., Chicago, was the technical speaker at the dinner meeting of Worcester chapter of ASTE held February 3 at Putnam and Thurston's Restaurant.

Among the 65 members and their guests present were Richard A. Smith, past chairman of Hartford chapter, and Robert L. Gay, area captain for the National Membership Committee.

The following slate of officers was presented by Ralph Baker, chairman of the nominating committee, and elected by vote of the members:

John E. Rotchford, chairman; Louis J. Furman, first vice chairman; Adam Kosciusko, second vice chairman; Irving England, secretary; and Andrew Peterson, treasurer. E. Roland Ljungquist, retiring chairman, was elected both ASTE delegate and ASTE Councilor to the Worcester Engineering Society. Ralph Baker was named alternate delegate. —*Harold F. Thompson*

Wichita Chapter Welcomes ASTE Officers

Wichita—National Officers' Night was held February 11 by members of the Wichita ASTE chapter. Special visitors participating in the meeting program were Harold E. Collins, national secretary for 1952-53; Howard C. McMillen, national treasurer for 1952-53; and W. G. Ehrhardt, a national director of ASTE.

As coffee speaker, Mr. Collins recounted highlights of his experiences in Europe while acting in an advisory capacity to the joint industry mobilization group of the machine tool industry and as a member of the tool committee of the Army Ordnance Assoc.

The meeting also served as the annual election of officers for the chapter. A. A. Reddy was named chairman and delegate; R. O. White, first vice chairman and alternate delegate; James H. Janson, second vice chairman; Walter E. Burnham, third vice chairman; Norman Watkins, secretary; and Paul Hess, treasurer. *—John G. Temple*

Guests of the Wichita chapter and the new officers are shown at the February meeting. Seated, from left: E. M. Pearne, DoAll Co.; H. E. Collins, national ASTE officer; W. G. Ehrhardt, national ASTE director; and H. J. Bales, first vice chairman, 1952-53. Standing: Norman Watkins, secretary; J. H. Jansen, second vice chairman; A. A. Reddy, chairman; R. C. White, first vice chairman; W. E. Burnham, third vice chairman; and P. R. Hess, treasurer.

Officers Named by Toronto Members

Toronto—Headed by David Few as chairman, a new slate of Toronto ASTE officers was named at the February 4 meeting held in the Oak Room of the Union Station. Cliff Farr was elected first vice chairman; Bruce Fairgrieve, second vice chairman; William H. Weatherhead, third vice chairman; Ken Laidley, secretary; and Eric Browne, treasurer.

"Hydraulic Tooling in Industry" was discussed by the technical speaker, R. H. Behrend, tooling superintendent, Denison Eng. Co. *—A. McKinney Rice*

Tour New Plant of United Aircraft Corp.

Windsor Locks, Conn.—Some 250 members of the Hartford chapter of ASTE participated in February 3 meeting held at the new plant of the Hamilton Standard Div., United Aircraft Corp. The evening's program included dinner, a plant tour and the annual election of officers. I. F. Holland, past president of the Society, was present for the session.

Omer A. Gingras was named chapter chairman; Edward T. Ross, first vice chairman; Robert Gay, second vice chairman; Henry Gotta, secretary; and Harry W. Anderson, treasurer. Henry Kuryla was named chapter delegate and Omer A. Gingras alternate delegate.

An early dinner in the company cafeteria was followed by a tour of the aircaft propeller manufacturing and assembly departments. *—John Hand Conard*

New Officers Elected by Pittsburgh Chapter

Pittsburgh—One hundred members of the Pittsburgh chapter met February 6 at the Sheraton Hotel for the annual election of officers. When the ballots were cast and the votes counted, L. J. Brozek was named chairman; Elwood W. Weissert, first vice chairman; R. S. Mason, second vice chairman; H. W. Bray, secretary, and John L. Sullivan, treasurer.

"Materials Handling" was discussed by the technical speaker, L. J. Johnson, assistant sales manager, Mathews Conveyor Co., Elwood City, Pa.

—E. L. Caughey

Richard Niebusch New Cincinnati Chairman

Cincinnati—Richard B. Niebusch was elected chairman of the Cincinnati ASTE chapter at the February 10 meeting held at the Engineering Society of Cincinnati. Other officers who will conduct ASTE activities during the next year are: Joseph C. Maezer, first vice chairman; Robert M. Shumway, second vice chairman; Frank Heap, secretary; and John H. Elfring, treasurer.

Program features included dinner, a movie on the lumber industry and a technical lecture. Guest speaker was L. D. Richardson, welding consultant and divisional sales manager, Eutectic Welding Alloys Corp., New York, N.Y.

—Louis H. Schumann

Frederick Preator Elected ASTE Chairman

Salt Lake City—The new chairman of the Salt Lake City ASTE chapter is Frederick Preator who was elected to the chapter's highest office at the February 13 meeting. Serving with him are Ray Hogan, first vice chairman; Harry Todd, second vice chairman; Joe Oviatt, secretary; and John Bennon, treasurer.

Propeller assembly operations at Hamilton Standard Div., United Aircraft Corp., are explained to members of the Hartford ASTE chapter who toured the new plant at Windsor Locks, Conn., on February 3.

Hamilton District Chapter Elects 1953-54 Officers

Hamilton, Ont.—At the annual election meeting of the Hamilton District chapter held February 13, Clarence E. Bulmer was named to head ASTE activities for the coming year. Serving with him are: John M. Snyder, first vice chairman; Frank Johnson, second vice chairman; Joseph A. Sheldon, third vice chairman; Harry B. Ward, secretary; and Ralph G. Fechnay, treasurer. William M. Shaw and George Churchill were elected delegate and alternate delegate.

The technical talk was given by Jack Yorick, general foreman, Hamilton Works, Studebaker Corp. He spoke on quality control and how it is applied to a modern automotive assembly line.

Mr. Yorick outlined the four basic check stations and showed slides of the various check charts, telling how this information is gathered, statistically evaluated and how it is applied to pinpoint trouble spots so corrections can be made quickly. *—John Litwin*

A photograph taken of the speakers' table at the February 13 "Members' Night" meeting of the Hamilton District chapter shows, from left: J. E. Yorick, past chairman; William Shaw, chairman; William Dawson, past chairman; Clarence Bulmer new chapter chairman; C. A. Fisher and F. O. Johnson.

ASTE Representatives Visit Portland Members

Portland, Me.—Three national officers of ASTE were special guests at the February meeting of the Portland chapter. Attending the session held at the Columbia Hotel were Joseph P. Crosby, second vice president; Gerald A. Rogers, assistant secretary-treasurer; and Robert Gay, area membership captain of the National Membership Committee.

The program included brief talks by the national officers, the annual election of officers, a technical lecture on "Modern Developments in Tool and Die Steels," and the presentation of the chapter's most valuable member award.

The service pin, presented annually to the most valuable member of the Portland chapter, was awarded to Edwin R. Andrews, past chairman of the chapter.

Delivering the technical address was Dr. Stewart G. Fletcher, chief metallurgist, Latrobe Steel Co., Latrobe, Pa., who was assisted by William McCarty, sales engineer with the firm. Films illustrated their presentation which was followed by a spirited question and answer period.

New officers of the chapter are: Faye B. Taylor, chairman; Harold Chaplin, first vice chairman; Harold Hopkins, second vice chairman; Howard Stevens, secretary; and Frank E. Thomas, treasurer. *—Clifford B. Smith*

DeLalla Named Sales Manager

Ernest N. DeLalla has been appointed sales manager of Cox Engineering & Sales Co., Detroit manufacturers and distributors of industrial hydraulic and lubricating equipment. He has been sales engineer with the company since 1949.

National Officers Visit San Gabriel Valley ASTE

Azusa, Calif.—Ninety-seven members and guests, representing 36 industrial plants located in the San Gabriel Valley, were present for the February election meeting of the San Gabriel Valley chapter of ASTE.

L. B. Bellamy, national ASTE president for 1952-53; Ben Hazewinkel, a national director for 1952-53; Wayne Ewing, member of the National Membership Committee; and Ralph Chrisse, chairman of the Los Angeles chapter, were honored guests at the dinner meeting held at the Rainbow Club.

Officers elected are: Peter Carter, chairman; Lincoln Mager, first vice chairman; Ed Cutler, second vice chairman; Nevin Byrd, secretary; Irving Greensides, treasurer; and Ed Smith alternate delegate.

On February 11 a number of members, headed by Chairman Carter, took 15 college students to Los Angeles to attend the Pameco Welding show.

—Peter Carter

Nearly 100 persons turned out for the February meeting of the San Gabriel Valley ASTE chapter. The candid camera snapped a few of them while they were at dinner. The left hand photo shows a more formal grouping of chapter officers and the four guests who attended the session. Seated, from left: Wayne Ewing, National Membership Committee; Ben Hazewinkel, a national director; L. B. Bellamy, president for 1952-53; Peter Carter, newly elected chapter chairman; and Ed Smith, 1952-53 chairman. Standing: Art Hoagland, 1952-53 second vice chairman; Ralph Chrissie, 1952-53 chapter chairman from Los Angeles; Irving Greensides, treasurer; Warren Prince, 1952-53 program chairman; Nevin Byrd, secretary; Ed Cuttler, 1953-54 second vice chairman; and Lincoln Mager, 1953-54 first vice chairman. The meeting was held in Asusa.

Obituaries

William H. Bruening, a former president of the Bruening Products Corp. and a member of the Rochester chapter of ASTE, died on January 29 at his home in Fairport, N. Y., at the age of 72. He had been ill a year.

In 1938 Mr. Bruening helped organize the Bruening-Winans Corp. to manufacture aircraft parts. He became sole owner in 1945. After selling the firm in 1949, he joined the Todd Co. in Rochester and later joined Stever-Locke Specialties, Inc. as a mechanical engineer.

Mr. Bruening began his career in 1902 as an apprentice for an outboard motor company in Detroit. In 1907 he went to Rochester where he was associated with a number of firms, including the Kellogg Mfg. Co. and the Vogt Tool Works.

Archibald N. Goddard, 80, a founder and chairman of the board of Goddard and Goddard Co., Detroit manufacturers and milling-cutter engineers, died February 24 at Key West, Fla. He was a charter members of ASTE.

He held honorary doctorate degrees from Wayne University and Worcester Polytechnic Institute. He was a charter member of the Engineering Society of Detroit and a past member of the American Society for Metals.

Mr. Goddard was also a life member of the American Society of Mechanical Engineers. He held the office of treasurer of the Detroit chapter at different times. He was founder and first president of the Michigan Mineralogical Society and served as a trustee of the Cranbrook Institute of Sciences, Bloomfield Hills, Mich.

He resigned as president of his firm, becoming board chairman, in 1947. A son, Emmons A. Goddard, assumed the post he left. Another son, Lewis H., is vice president of the company.

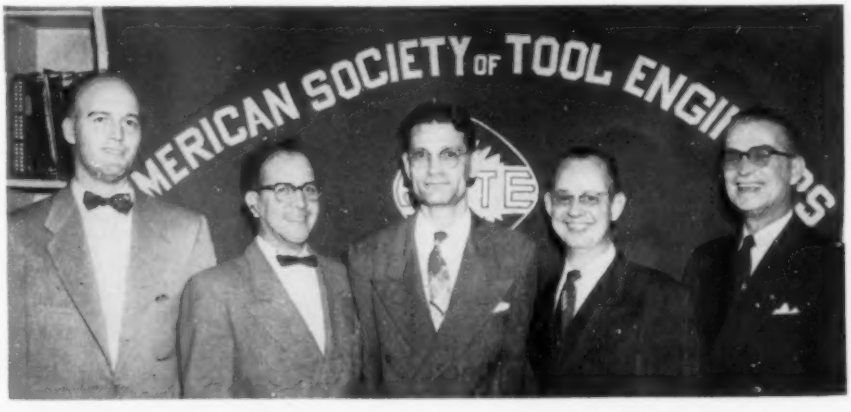
John A. Hayes, chief tool engineer for the Draper Corp., Hopedale, Mass., died on January 22 after nearly 30 years of service to the company. He was 64.

Mr. Hayes was promoted from assistant chief draftsman to chief tool engineer in 1943. A graduate of the Massachusetts Institute of Technology, he was a member of the Worcester chapter of ASTE.

John M. Macrae, 65, manager of the Deroit office of Greenlee Brothers and Co. since 1935, died on February 12 while on a business trip in Rockford, Ill. A resident of Birmingham, Mich., Mr. Macrae was a member of the Detroit chapter of the Society. He had been associated with Greenlee Brothers for 20 years.

Fred J. Schmitt, far right, a national director of ASTE, swore in charter officers of the Louis Joliet chapter February 17 at a meeting at the Hotel Woodruff, Joliet, Ill. Repeating the oath of office are; Harold Zierke, far left, secretary; Francis Bowers, treasurer; Jack Stacy, second vice chairman; and Harry Moffat, chairman. Don Stanfield is first vice chairman of the chapter. ***—Harold Zierke***

More than 400 members and guests of the Northern New Jersey chapter turned out for the annual dinner dance held February 6 at Donahue's Restaurant in Mountain View, N. J. A heart roast beef dinner and a program of top-flight entertainment highlighted the affair. Corsages were presented the ladies from the chapter. Pictured, from left, are: Arthur J. Wojtowicz, treasurer; R. Wilson Ryno, secretary; Carl L. Slonkosky, entertainment chairman; Clyde C. Shannon, chairman; and James Allan, past chairman. ***—Anthony F. Cuoco***



The first group picture taken of the new Houston ASTE officers shows: Paul Langdale, treasurer; J. D. Bailleres, secretary; J. W. Hindman, Jr., second vice chairman; H. G. Boswell, first vice chairman and H. O. Traygher, chairman.

Frank Elliot Heads Los Alamos Chapter

Los Alamos, N.M.—The latest developments in the processing of aluminum were reviewed at the February 11 meeting of the Los Alamos ASTE chapter by J. K. Wareham of the Alcoa Aluminum Corp., New Kensington, Pa. He discussed the proper grades of aluminum to use in drawing, stamping, stretching, spinning, resistance welding, and finishing. His lecture was illustrated with movies and a number of slides.

About 40 members and guests, including O. Christy Jones of Alcoa's Oklahoma City office, attended the technical session held at the Los Alamos high school.

A portion of the meeting was devoted to the annual election of officers. Serving the chapter for the coming year are: Frank J. Elliot, chairman; Robert H. Moeller, first vice chairman; Virgil B. Brown, second vice chairman; Joseph B. Bourne, secretary; and Harold H. Hawk, treasurer.

—Herman J. Von Steeg

Niagara District Chapter Names 1953-54 Officers

Welland, Ont.—At the annual election of officers held February 5 members of the Niagara Dictrict chapter named the following men to lead ASTE activities during the next year: Albert Clarkson, chairman; Cyril Mitchell, first vice chairman; Harold Crawford, second vice chairman; Gordon Bishop, secretary; and Edward Donegan, treasurer. The meeting, held at the Barclay Hotel, was attended by about 55 persons.

The guest speaker was N. C. Taylor, service engineer, Eastman Co., Kingsport, Tenn. He discussed "The Story of Tenite," using sound and colored movies for illustration.

Tenite, known as a plastic, is very light and tough. Weighing half as much as aluminum, it is made from cotton which is dissolved by a special process.

Football helmets are now being made from this material. Movie film is another application, as are irrigation tubing, telephone sets, vacuum cleaner accessories, door handles and knobs.

The product has brought unlimited possibilities to tool engineering. Eastman has a mold that produces four reflectors every 45 seconds. The parts come out with a smooth finish which looks like highly polished steel when they are metallized. While the cost of this tool is quite high, the resultant product is economical due to the high production of a finished part which requires no buffing or polishing.

—William A. Yaeger

H. L. Tigges, past national president of ASTE and a past chairman of the Toledo chapter, presents scholarship to Robert W. Fern, University of Toledo student.

Tigges Awards Toledo's Annual ASTE Scholarship

Toledo—The annual scholarship of the Toledo chapter was presented at the January meeting by Herbert L. Tigges, past national president of ASTE. Recipient of this year's award was Robert W. Fern, an engineering student at the University of Toledo. Qualifications for the two-hundred-dollar scholarship include good academic standing and participation in extra-curricular activities.

The presentation was witnessed by more than 80 members and guests at the Maumee River Yacht Club.

The technical program was presented by Prof. W. W. Gilbert, instructor in the production engineering department at the University of Michigan and a member of the National Education Committee. Speaking on "Application of Machinability Research," Prof. Gilbert explained how laboratory experiments help industry in overcoming problems in the industrial shop, particularly in proper machining of new elements and alloys.

—C. C. Hartwig

Hawes and Ewing Visit San Diego ASTE Meeting

San Diego—Among the 125 members and guests who were on hand for the February meeting of the San Diego chapter were Leslie F. Hawes, chairman of the National Public Relations Committee, and Wayne Ewing, area captain with the National Membership Committee. The evening's activities took place at the El Morocco Club and included dinner, a technical session, and the annual election of officers.

Headed by A. E. Crom as chairman, they are: Harry Applegate, first vice chairman; Jack McClure, second vice chairman; Kenneth Meer, secretary; and Clarence Boyle, treasurer.

The technical program was presented by William R. Richards of the Pacific Telephone and Telegraph Co. He spoke on the topic "Microwave Radio Transmission."

—Clyde L. Good.

Nashville Groups Hold Joint Meeting

Nashville—A total of 125 persons attended the January 20 meeting sponsored jointly by the Nashville chapters of American Society of Tool Engineers, American Society of Mechanical Engineers, and American Institute of Electrical Engineers at Vanderbilt University. Bruce Bayer, vice chairman of ASME, and J. M. Pinkerton, chairman of AIEE, were among the society officers present for the technical session.

Speaker for the evening was Dr. H. B. Osborn, Jr., national officer of ASTE and technical director of the Tocco Div., Ohio Crankshaft Co. Dr. Osborn spoke on induction heating and showed movies covering his topic. A lively discussion period followed his discussion.

—J. E. Riordan

Technical speaker at a joint meeting of the Nashville chapters of ASTE, ASME and AIEE, was Dr. Harry B. Osborn, Jr., second from right, a national officer of the Society and technical director of the Tocco Div., Ohio Crankshaft Co. Shown with him, from left, are: John Gipson, ASTE chairman, J. M. Pinkerton of AIEE and Bruce Bayer of ASME.

Mohawk Valley Members Meet with ASM Chapter

Utica, N. Y.—At a joint meeting with the Rome chapter of ASM held February 3, Mohawk ASTE chapter heard a discussion on the heat treatment of steel by Dr. Morris Cohen of the Department of Metallurgy, Massachusetts Institute of Technology.

Dr. Cohen discussed the hardening and tempering of steel in terms of the structural changes that underlie these heat treatment operations. Recent investigations of the martensitic transformations were reviewed. Emphasis was placed on the stages of tempering that govern the ultimate combination of properties in obtaining optimum strength, toughness and dimensional stability.

ASTE chapter officers elected at the meeting include: Earl Wheat, chairman; Nick Kenney, first vice chairman; Earl English, second vice chairman; and Paul Lyman, secretary. Albert Delmont was named delegate and Dick Lauterback alternate delegate.

The January meeting featured a buffet supper arranged by Bernard Legro through the courtesy of Syracuse Supply Co. Held at the City Club in Utica, the technical program was presented by J. B. Kennedy, manager of product projects, Carboloy Dept., General Electric Co., Detroit. He spoke on "Cemented Chrome Carbides."

—Raymond B. Hurley

Hilton Van Phipps Elected Pontiac Chairman

Pontiac, Mich.—Three members from the Saginaw Valley ASTE chapter, Glen Fitzgerald, William Bailey and Warner Remington, were guests at the February election meeting of the Pontiac chapter. More than 100 persons attended the dinner session held at the Old Mill Tavern in Waterford.

Hilton Van Phipps was elected chapter chairman for the coming year. Other officers chosen include: Eric A. Ericson, first vice chairman; D. H. Inman, second vice chairman, John Fitzgerald, secretary; Ernest La Forest, treasurer; R. J. Hayward, delegate; and J. McDonald, alternate delegate.

The technical program was presented by Chester S. Johns, industrial engineer, The Cross Machine Co., Detroit. He was assisted during the discussion period by Thomas Evans, Robert Read and David Dumond.

The topic for discussion was "The Automation Story." Mr. Johns devoted his lecture to the conditions under which auomation may be used, the benefits that may be derived and the problems that may arise. *—T. R. Gibson*

St. Louis Chairman Huchzermeier makes service award to Henry R. Rebesberger at February meeting.

Three Montreal Speakers Review Telephone Tooling

Montreal—Some 120 Montreal ASTE members and guests were present for the February 12 meeting held at the Technical School to hear a discussion on "Progress in Telephone Tooling."

The program was presented by three speakers from the Northern Electric Co., Ltd., Montreal, G. M. Foster, M. D. Johnson, and G. W. K. Clark. Mr. Foster acted as chairman.

One phase of the program highlighted the rapid growth in the telephone industry and pointed up the various problems that have been overcome by special tooling. Increased production of telephone instruments was illustrated by a movie film in the plant of Northern Electric Co.

—Frank Winkworth

McClellan Visits St. Thomas Meeting

St. Thomas, Ont.—W. B. McClellan, a national director of the Society for 1952-53, was a special guest at the February 19 meeting of the London-St. Thomas chapter held at the Terrace Club. The sesion was attended by about 75 members and guests.

At the annual election of officers held that evening, Lou Jenson was named chapter chairman; Fred Lewis, first vice chairman; Al Trueman, second vice chairman; John Ayling, third vice chairman; George McRea, secretary; and Roy Brown, treasurer. Al Ward was named delegate and Bert Smith, alternate delegate.

Technical speaker for the evening was Robert Bristol, sales engineer, Pivot Punch & Die Corp., North Tonawanda, N. Y. His subject was "The Application and Uses of Pivot Punches."

The speaker was introduced by Mr. Trueman and thanked by William Lyons. Mr. Ward was chairman for the evening. *—Robert Fraser*

Old Timers' Night Scores Success in St. Louis

St. Louis—Willis J. Potthoff was elected chairman of the St. Louis chapter at the election meeting held February 5 at the DeSoto Hotel. Serving with him during the coming year will be: Irwin J. Schumaier, first vice chairman; Harold N. Zimmerman, second vice chairman; Richard D. Bardes, secretary; and Oliver L. Scott, treasurer; E. P. Huchzermeier was named delegate and Mr. Potthoff was chosen alternate delegate.

Chairman Huchzermeier presented the service award pin to Henry R. Rebesberger and gave a short history of the chapter. The activities of the past year were reviewed by William Scheer.

The theme of the technical program was "Old Timers Night," establishing another 'first' for the chapter. Program responsibilities were shared by three speakers, Ernie Nieman of Precision Automotive Components Co., Clarence Miller of Measuregraph Co., and Lou Greenblatt of Greenleaf Mfg. Co.

Mr. Nieman spoke on "Tool Engineering of the Past" and explained how mass production methods were begun without the advantage of extensive engineering knowledge.

In his discussion on "Tool Engineering as We See It Today," Mr. Miller told how transportation and modern conveniences prove how profitable tool engineering is.

Mr. Greenblatt, discussing "Tool Engineering in the Future," explained the need for more optical equipment and more gaging by electronics and how nuclear energy is being made useful to the tool engineer and related other new developments which are important to tool engineering. *—Harold W. Bachman*

Long Island Members Elect Arthur Cervenka

Garden City, New York—The election of chapter officers for 1953-54 was the highlight of the February 9 meeting of the Long Island ASTE chapter held at the Garden City Hotel.

Arthur Cervenka was chosen chapter chairman and alternate delegate; George Bennett, first vice chairman; George McLaughlin, second vice chairman; John Hatter, secretary; Max Stein, treasurer; and Sheldon Meyers, delegate. The men who served on the nominating committee were Don L. Griffing, chairman, Max Stein and Henry Maehl.

The rest of the evening's activities were devoted to the showing of a travel film and a talk on the 1952 ASTE annual meeting by Mr. Meyers.

—Sara T. Moxley

Arthur Kuris Explains Ultrasonic Machine Tool

Poughkeepsie, N. Y.—Arthur Kuris, president of the Gavitron Equipment Corp., Long Island City, addressed about 140 members and guests of the Mid-Hudson chapter at their meeting held on February 10 at the Nelson House.

Mr. Kuris spoke on "The Ultrasonic Machine Tool," one of the latest developments for the machining of hard and brittle materials. Classified as an impact grinding method, the process employs no electric sparking and will not erode or change the surface of the material in any way.

The equipment consists of an oscillator, transducer, amplifier and the tool. Current passing through the transducer provides vibrations at the tip of from 0.0002 to 0.0003 inch. The amplifier, which is in the shape of a cone, is screwed onto the tip of the transducer and picks up and magnifies these vibrations, providing a stroke of from 0.001 to 0.004 inch. The amplifications can be varied depending on the curve of the amplifier and the ratio of the large diameter at the top to the small bottom diameter.

The tool, which is brazed into position on the end of the cone, is generally made of soft steel, the end being shaped to the desired contour. With a continuous flow of a mixture of abrasive and water between the end of the tool and the work, the tool under a light but continuous pressure sinks into the workpiece by means of the vibrations.

During the business meeting, conducted by Chairman Joseph A. Crane, the following members were elected to serve as officers for the coming year: Stanley P. Cook, chairman; Henry J. Tesmer, first vice chairman; Richard Fitzgibbons, second vice chairman; Felix Adams, secretary; and J. Harry Keller, treasurer.

Eugene Roth, chairman of the Greater New York chapter, was a guest at the meeting and invited Mid-Hudson members to attend the Tool Engineer's Day scheduled for April 14. —*S. P. Cook*

There were smiles all the way around when the new officers of the Rochester chapter had their picture taken at the February election meeting. Bottom row: William B. Kamola, second vice chairman; John Lawrence, third vice chairman; Donald F. Kohler, chairman; and Charles DeMartin, delegate. Top row: Ford M. Sears, treasurer; Ralph Vigma, secretary; Floyd Weed and James Palmer, members of the executive committee; and G. K. Sick, first vice chairman.

Olaf Hammer Presents Potomac ASTE Program

Washington, D.C.—About 75 members of the Potomac chapter were present February 5 for the election meeting held at the Hamilton Hotel. Unanimous ballots were cast for the following officers: George M. Beck, chairman; William F. Hefferman, first vice chairman; Wayne L. Boyer, second vice chairman; Albert F. Shockey, secretary; James M. Cole, treasurer; William E. Jones, delegate; and George M. Cohn, alternate delegate.

A talk on sheet metal and plate cutting machines was given by Olaf T. Hammer, eastern representative, American Pullmax Co., Chicago. He described the versatility of the Pullmax machine and showed a movie filmed at the firm's home plant in Sweden which pictured the development and manufacture of the novel machinery.

—*E. C. Austin*

Speakers Discuss Press Applications

Elmira—Three films describing Denison hydraulic presses, were shown at the technical program of Elmira chapter's February meeting. Guest speakers from the firm were H. M. Borror, field engineer, and Francis R. Springer, eastern divisions manager. They explained and showed various ways of using Denison presses and conducted a discussion period.

Elmira members held their annual election of officers at the meeting and selected Edwin C. Bates for their 1953-54 chapter chairman. Serving with him are: Charles Roe, first vice chairman; Francis Shepherd, second vice chairman; Arthur Green, secretary; Michael J. Buffalin, treasurer; Raymond Banfield, delegate and Mr. LeMaire, alternate delegate. —*Raymond Banfield*

Edwin C. Bates was named chairman of the Elmira ASTE chapter at the annual election of officers.

Kohler Elected Rochester Chairman

Rochester—Speakers at the February session of the Rochester ASTE chapter were Marine Staff Sergeant L. F. Maxwell who showed films taken in the South Pacific during World War II and James Tipton, Cincinnati Lathe and Tool Co., who presented a program on "The Cincinnati Tray Top Lathe."

About 100 members and guests were present for the technical meeting and the annual election of officers. Donald F. Kohler was elected chapter chairman. The men serving with him are: G. K. Sick, first vice chairman; William B. Kamola, second vice chairman; John Lawrence, third vice chairman; Ralph Vigna, secretary; and Ford M. Sears, treasurer. Charles DeMartin was named delegate and Mr. Kohler was named alternate. Sherman Hagberg, Floyd Weed, and James Palmer will serve on the executive committee.

—*Paul Bruno*

Donald McMillan Heads Saginaw Valley Chapter

Frankenmuth, Mich.—Donald A. McMillan was named chairman of the Saginaw Valley ASTE chapter at the annual election of officers held at Zehnder's Hotel. Other new officers are: A. W. Blackmon, first vice chairman; S. A. Mathews, second vice chairman; Charles E. Bierwirth, secretary; Harold W. Snider, treasurer; Clyde L. Fanning, delegate; and Michael Skunda, alternate delegate.

Guest speaker for the evening was Dr. Stewart G. Fletcher, chief metallurgist, Latrobe Steel Co. He spoke on the selection and heat treatment of tool and die steels. A movie was shown on "The Story of High-Speed Steel and Die Steels." —*Ben Phillips*

Films on Verson Presses Shown by E. J. O'Connell

Galt, Ont.—Featured speaker at the January meeting of the Grand River Valley ASTE chapter was E. J. O'Connell of the Verson Allsteel Press Co., Chicago. He spoke on presses and tooling, using two films to illustrate his material.

One movie was on the subject of transmat press work and showed in detail the sequence operations performed in the manufacture of various components of different sizes and shapes. Tooling setups with material flowing both from end to end and back to front of the press bed were seen as were several unique methods of scrap disposal.

The complete tooling for the major components of the Maytag washing machine was pictured in the other film. Various types of presses were seen operating with material flow from press to press being carried out by means of gravity conveyors. The technical program was concluded with a stimulating question and answer period.

—W. H. A. Lambert

Instructor Addresses Santa Clara Chapter

Meeting at the Red Coach Inn, more than 100 members and guests of the Santa Clara Valley ASTE chapter heard a technical address made by Stanley R. Cope, Acme School of Die Design Engineering, South Bend, Ind. He spoke on processing and designing dies for deep-drawn stampings.

A nominating committee was chosen to select the slate for the annual election of officers. William Forbes was named chairman, assisted by Richard Andrews and Bud Weaver.

The business meeting and technical session were preceded by dinner.

—William Lanyon

Rhodehamel Speaks on Multiple Spindle Tooling

Bridgeport, Conn.—"Multiple Spindle Tooling" was the subject discussed by Robert R. Rhodehamel, general sales manager, National Acme Co., Cleveland, when he spoke at a recent meeting of the Fairfield County ASTE chapter. About 80 members and guests attended the dinner session held at the Hitching Post Inn.

Mr. Rhodehamel stressed the savings involved in multiple tooling as compared to single tooling. He also discussed tool life and showed some very excellent slides of the different types of multiple spindle machines.

—John Bodnar

Coming MEETINGS

TOOL ENGINEERING CONFERENCE—April 18, Purdue University, Lafayette, Ind. Sponsored by Evansville, Fort Wayne, Indianapolis, Muncie, Richmond and South Bend ASTE chapters.

TOOL ENGINEERS' DAY—April 14, 7:30 p. m., Hotel New Yorker. Principal speakers will be Harold S. Vance, president and chairman of the board of the Studebaker Corp. and consultant to the office of Defense Mobilization; and Lt. Gen. K. B. Wolfe (Ret.), president of Oerlikon Tool and Arms Corp. of America. Sponsored by Greater New York, Long Island, Northern New Jersey, Paterson, Mid-Hudson, and Fairfield County ASTE chapters.

BOSTON—April 9, 6 p. m., New England Mutual Hall. "Principles of Metal Cutting" by M. C. Shaw.

CHICAGO—April 6, Keyman's Club. "Gaging" by W. Faye Aller, director of research, Sheffield Corp., Dayton.

CINCINNATI—April 14, "Graphite Tool Steel" by A. F. Sprankle, Timken Steel & Tube Div.

CLEVELAND—April 10, Ladies' Night.

COLUMBUS—April 8, 6:30 p. m., Columbus Maennerchor. "The Use and Abuse of Twist Drills" by D. R. Paskey, service representative, The Cleveland Twist Drill Co., Cleveland, O.

FAIRFIELD COUNTY—April 1. "Industrial Diamonds and Diamond Tools" by a representative of Molina Industrial Diamond Co., Inc.

GRAND RIVER VALLEY—April 3. Plant tour of A. C. Wickman Machine Tool Specialists, Toronto.

HARTFORD—April 6. Hartford Gas Auditorium. "Toolroom and Tracer Lathes" by Mr. Brandenberg, sales manager, Monarch Machine Tool Co.

HOUSTON—April 10, 6:30 p. m., Ben Milan Hotel. "Production Tooling Problems" by Harry Conn, chief engineer, Scully-Jones and Co., Chicago.

INDIANAPOLIS—April 2. "The Hydroform, A New Kind of Machine Tool" by K. P. Martin, Cincinnati Milling and Grinding Machines, Inc.

LITTLE RHODY—April 2. "Carbide Applications in Various Turning Operations" by William P. Coomey, general superintendent, Rice-Barton Corp., Worcester, Mass.

LEHIGH VALLEY—April 24, 6:15 p. m., Hotel Traylor, Allentown, Pa. Buses leave for tour of Textile Machine Works in Reading, Pa.

LONG BEACH—April 8. "Selection and Use of Tool Steels" by L. V. Klaybor, Allegheny Ludlum Steel Corp., Pittsburgh.

LOUISVILLE—April 14. "Method X" by M. F. Judkins, Firth-Sterling Steel & Carbide Corp., Pittsburgh.

MILWAUKEE—April 9. Plant tour of the Globe Steel Tubes Co., 3839 W. Burnham St., Milwaukee.

NASHVILLE—April 21, B. & W. Cafeteria. Program on Monarch Lathes by a representative of the Monarch Machine Tool Co.

NEW ORLEANS—April 8. Program on gears.

PEORIA—April 2. Annual Ladies' Night.

PETERBOROUGH—April 2. "Telescopes and Machine Tools" by a representative of Warner & Swasey Co.

PIEDMONT—April 13, 6:30 p. m., Mecklenburg Hotel, Charlotte, N.C. "Getting the Most Out of Stainless Steels in the Fabrication Processes" by E. W. Hopper, chief chemical engineer, Crucible Steel Co.

PITTSBURGH—April 8, Ladies' Night.

PORTLAND, Me.—April 10, 7 p. m., Penobscot Hotel, Bangor, Me. "Materials Handling" by Clement N. Williams, sales engineer, Brodie Industrial Trucks, Inc., Malden, Mass. This program will be preceded by a plant tour of the Eastern Corp. Paper Mills scheduled for 2 p. m.

SANTA CLARA VALLEY—April 14, 6:30 p. m., Longbarn, Palo Alto. "Tool Steels" by L. V. Klaybor, associate director of research, Tool & Die Div., Allegheny Ludlum Steel Corp., San Francisco.

SCHENECTADY—April 9. "Optical Flats and Their Use for Measuring" by Frank Clark, secretary, The Van Keuren Co., Watertown, Mass.

SPRINGFIELD—April 7. "Tool Failures and Tool Troubleshooting" by J. Y. Riedel, Bethlehem Steel Co.

TORONTO—April 1, 6:30 p. m., Oak Room, Union Station. "Hydraulic Applications" by G. B. Miller, chief engineer, Racine Hydraulics and Machinery Corp., Racine, Wis.

TRI-CITIES—April 8. Plant tour of Gale Products Co., Galesburg, Ill.

TWIN STATES—April 8, Windsor House, Windsor, Vt. "Industrial Design" by Herbert Rosengren.

West Coast News

By Andrew E. Rylander

Another interesting month winding up, this time in a howling gale. That jar that just shook the house was a big pine blown down across the road.

During the month, the long awaited visit from Pete Dubois, GM of Swartz Tool Products. As a result, had news of *auld acquaintance* in my erstwhile home—the first in many moons outside of what I get from Detroit chapter's *Toolcast* for which thanks a lot. With Pete was Ernest Johnson of Chicago, with whom I exchanged reminiscences of mutual acquaintances in the Windy City. An enjoyable get-together.

Also a visit from Ed and Mrs. Raves, Ed being a charter member of Golden Gate chapter and jolly well liked by a host of friends. Through him, got acquainted with Carl Peterson, chief tool engineer with Merco Nordstrom Valve Co. and living in Concord which is a suburb of Walnut Creek or vice versa. Also, and hoping I'm reading my notes aright, another Walnut Creek ASTEer by name Chet Tarne, recently in from Chicago and now with Kaiser Steel.

Visits Railroad Shops

Thanks to Evans Porter, sales engineer with Moore Machinery Co. and member of Golden Gate chapter, enjoyed an extensive visit through the Southern Pacific company's Sacramento shops. There, T. E. Malloy, Asst. Supt. of Motive Power—which means the Big Wheel in railroad circles—turned the emceeing over to Ernest (Barney to his friends) Stapeley, an old-timer whose service stars would equal the stripes of a retired master sergeant.

What impressed me the most was the difference between "then" and now, it so happening that I put in my lick in a locomotive shop way back when. Then, the typical railroad shop was reminiscent of William's cartoons—and are they nostalgic! However, one learned a lot.

Basic manufacturing procedures haven't changed materially, but modern automatic tools and good housekeeping put the SP shops in a class with a well-appointed toolroom. Then too, diesels have changed the picture considerably, apropos which I was somewhat surprised to learn that they're cutting out honing of engine cylinders. Instead, the cylinders are bored to a fine surface finish and then chrome-plated. The result is greatly extended life.

On invitation from both Golden Gate and Santa Clara Valley chapters had the pleasure of attending their joint executive meeting, held in San Mateo, at which Prex Les Bellamy was guest of honor. Adding to the occasion was a coincidental surprise visit from Director Ben Hazewinkle, Public Relations ch'man Les Hawes, and Wayne Ewing, 1st VC of the Nat'l Program Com'tee. Me, I ran on a split ticket, first being included in the Santa Clara group by Vince Diehl but finally claimed for Golden Gate by Ted Rohrer.

Prex Bellamy spoke "off the cuff" so to say, outlining Society procedures and answering pertinent questions. Left everybody considerably enlightened about the national ASTE picture. As an aside, we organized a crew cut club, charter members including myself, Don Locke, and Karl Bues, with E. F. (Rock) Roskowski as model for style. Les Bellamy was made an honorary member.

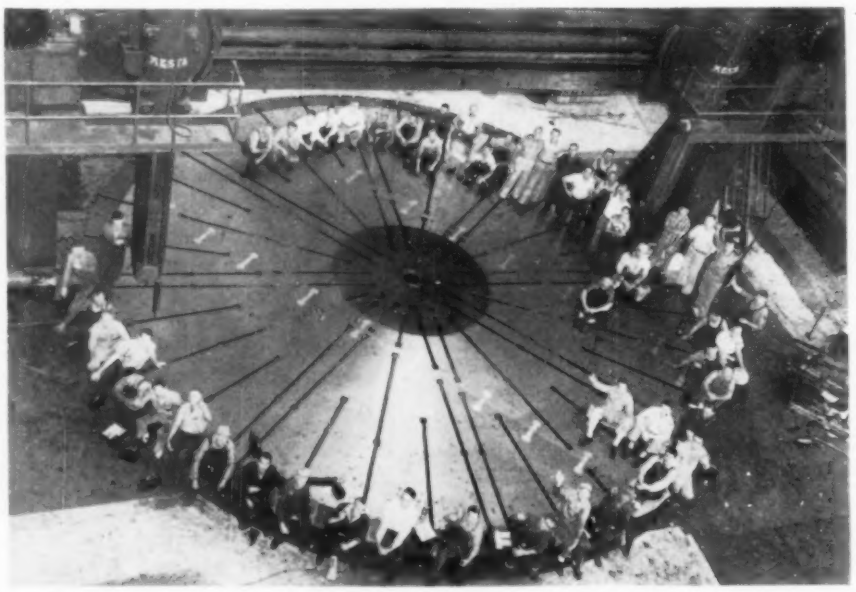
At the Golden Gate February meeting, Wm. M. Carson of The Carborundum Company was commentator for a sound movie—"Romance in Industry"—put out by Carborundum. Actually, Mr. Carson gave a well-rounded and interesting talk on abrasives and their applications; that, and the excellent movie, rounded out the technical session.

Election of officers for the coming year included Dave Gustafson, Dean Roulund, Vern Gallichotte, Ted Lindquist, and Raymond Reed as chairman, 1st V. C., 2nd V. C., secretary, and treasurer in the order named, all unanimously voted in—a credit to the nominating committee headed by past ch'man Ben Berlien. Ted Rohrer, immediate past ch'man, was elected delegate, with Ed Raves alternate. All good men.

New Friendship

Extending my acquaintanceships, got to know Sanford Wixson of Yuba Mfg. Co., whom I've seen a number of times but somehow got confused with likeable Ed Harper with whom I was co-director some years ago. Wonder where Ed is now? And speaking of likeable guys, there's Hans Metz of Golden Gate chapter who is highly popular with his fellows. He has to be or they'd have shot him long ago. Anyway Hans is rated a topnotch die man and, from what I heard, has just gone into an extensive plant expansion. How about an article for THE TOOL ENGINEER, Hans?

Well, that's about all for now. The wind has died down while I've been writing and I want to go out and view the carnage. In closing, however, I might suggest that, in the previous letter, I mentioned a big Mesta boring mill at Westinghouse Sunnyvale plant, and just to show you that I wasn't exaggerating I'm submitting a pic for which thanks to Carl Albrecht. Quite a merry-go-round! See you again sometime.



Employes of Westinghouse Electric's western headquarters plant at Sunnyvale, Calif., celebrate installation of one of the largest machine tools in the world at a luncheon "round table." On the turntable and superstructure shown, called a horizontal boring mill, giant slabs of steel will be cut to precision for an air compressor being fabricated at the plant. The largest piece of rotating equipment in the world, the compressor is destined for an U. S. Air Force wind tunnel at Tullahoma, where it will whip up gales exceeding the speed of sound.

News in Metalworking . . .

TITANIUM INCREASE PLANNED

Expansion of DuPont's titanium sponge producing facilities is under way at its Newport, Del. plant, and is also scheduled to begin shortly at the Edge Moor, Del. plant. About 13,500 additional tons of titanium sponge are expected during the next five years as a result of this expansion which was undertaken at the request of the government.

This spongy form of titanium is made through a chemical process which leaves it about 99.5 percent pure. The sponge form is then melted and the ingots forged or rolled.

Perhaps one of the prime reasons for increasing the facilities at this time, of course, is titanium metal's great potentialities for defense as well as commercial applications. Alloys of the metal already developed have been proved stronger than some present steels while being 40 percent lighter. In addition, they have the advantage of being highly corrosion resistant, especially to salt water.

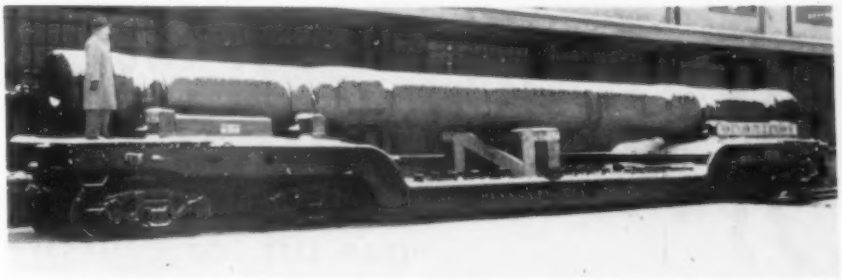
Prior to the outbreak of hostilities in Korea, only pilot-plant quantities of titanium sponge metal were available.

LEASE A LIFT— YALE & TOWNE STARTS RENTAL PLAN

A novel nationwide plan which permits users to lease industrial lift and fork trucks and allied equipment rather than buying them has been announced jointly by the Philadelphia Division of the Yale & Towne Mfg. Co. and C. I. T. Corp., the industrial financing subsidiary of C. I. T. Financial Corp.

The sponsoring organizations explained that the leasing plan will help many enterprises meet their expanding production and service requirements while avoiding the substantial capital investment required to purchase materials handling equipment.

The plan enables factories, warehouses, railroads and others to obtain materials handling equipment by paying monthly rentals as the machines are used. Under the program, the field sales organization of Yale & Towne's materials handling division at Philadelphia will negotiate leasing agreements for equipment with potential users. C. I. T. will then purchase the required equipment from Yale & Towne and lease it to the user for an agreed period of time.



This mammoth press tie rod gives an indication of the machine to come. Twelve rods similar to this 152-ton one will be used on the 35,000-ton and 25,000-ton closed-die forging presses being built by E. W. Bliss Co. as a part of the Air Force Heavy Press Program. Seventy feet long and with a maximum diameter of 45 inches, the rod, forged from a 250-ton billet, has been rough machined and now awaits final machining. An 18-in. hole bored through its entire length provides greater stiffness and improves stress characteristics around threads of the main tie rod nuts.

NEW HOME FOR TOCCO DIVISION

Tocco Div. of the Ohio Crankshaft Co. has gone to work in its newly constructed facility which was 25 months in the planning and construction stages.

The completed structure not only houses the manufacturing area, general laboratories and testing areas, but also makes room for the division offices, blue print room, engineering offices, photographic room, metallurgical and chemical laboratories, and several other company facilities. The building, 242 by 300 ft in dimension, is of monitor-type construction to simplify operations.

LET'S SAVE All FINGERS

They're Precious . . . and Costly!

SECOND FINGER $1,050.00
FIRST FINGER $1,200.00
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Keep Fingers Out of Presses!

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Blanks fed from a safe distance of 14 inches.
Pres-Vac operates from compressed air at 45 lbs. pressure which passes through a venturi to create a vacuum.

AMPUTATED FINGERS COME HIGH!
Above figures are based on maximum rate of Illinois Workmen's Compensation from Division of Statistics and Research, Illinois Industrial Commission. (Figures for some states are higher.)

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Blank parts weighing up to 2 lbs. are blown out of press with a standard Air Blast Valve.

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TIP TO INDUSTRY ON THE ENGINEER PROBLEM

More than 300 educators and industry representatives considered the critical problem American industry faces in trying to hurdle the gap between the increasing demand for engineers and the declining supply. The meeting came at Northwestern University's Technological Institute and its annual College-Industry Conference. As a result of discussions a number of suggestions were offered which could be the life net to hold an industry together.

Two major facts of our industrial world, and which form the problem, are that each year the nation needs for replacement alone, an estimated 30,000 new engineers. In 1953 colleges are expected to graduate about 24,000—and this number declines to 19,000 in 1954 and to 17,000 in 1955. These figures were presented by no less an authority than Clarence E. Deakins, dean of students at Illinois Institute of Technology, who went on to point out that in addition, the problem of recruiting engineering students is hampered by the fact that industry itself is in direct competition with colleges for the high school graduate. The very boy who possesses the mechanical skill and interest to justify engineering education, is the one attracted to high-paying industrial jobs. Parents may find it difficult to finance the education, so instead urge him to take advantage of the attractive jobs. One solution to this specific problem was through freshman scholarship programs. At present, such programs are mainly available to the junior and senior students.

Another suggested way to beat the engineer shortage was through training and using of skilled assistants. Titus G. LeClair, manager of engineering for Commonwealth Edison and Public Service Co. of Illinois, pointed out that requiring an engineer to handle all the details of his job is "our greatest source of wasted engineering talent."

The proposal for this situation was to give the engineer the help of a technical assistant, draftsman or clerk to relieve him of this paper and nontechnical activities. A skilled assistant, who may be a technical institute graduate or have one or two years of college, then permits the "scarce" engineer to turn quickly to other assignments without going on to do the detail work.

Mr. LeClair appealed to employers to alter their organizations to accommodate this type of technical assistant, promising a working return of 10 to 15 percent increase in the engineer's effectiveness. At the same time, mor-

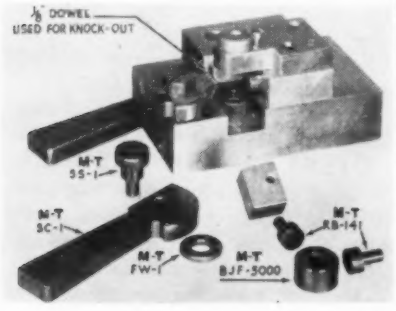
ale problems may smooth out since the engineer probably is better satisfied, because of better use made of his technical skills which obviously opens more opportunities for his advancement. By the same token, the technical assistant or clerk, who didn't have the opportunity to get a college education in the field, is happy to work in the field which furthers his training, and is work to his liking.

Speaking in the same vein, Prof. Kurt F. Wendt of the University of Wisconsin, a member of a panel on "Education and Training," said that if more young men were encouraged to take two years of training to prepare themselves for industrial positions which require much less training than is expected of engineering students, we can both increase our technical forces and use the supply of engineers more effectively.

INGENUITY SOLVES PROCESS PROBLEM IN A HURRY

With an eye toward the value of incorporating their own parts in their own jig and fixture design, process men at Morton Machine Works recently solved a rush demand for a replacement drill jig by using six of their standard catalog items; three pieces of cold rolled steel and standard replaceable bushing for its construction.

The urgency with which the jig was needed ruled out heat treating and grinding. Specifications called for a $\frac{3}{16}$ in. hole to be drilled and reamed



in a rectangular steel blank. This hole was dimensioned from two sides of the blank with limits of plus or minus 0.005; rate of production, 120 per hour; machine available, Walker-Turner bench drill of ¼ in. capacity; and tooling and unloading had to be rapid.

A single cam, equipped with a ⅛ in. dowel for knock-out solved this need. Utilization of two rest buttons and one button jig foot answered the need for hardened and ground wear and locating surfaces.

Through engineering ingenuity, the problem was met with a satisfactory solution with a total elapsed time for design and building of less than eight hours.

Production News

ABOUT *Lusol*.. —THE ALL-CHEMICAL METAL-WORKING SOLUTION

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No head colds—No dermatitis—
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Working conditions in the shop of the future will be as attractive as your office. Labor will have little cause for complaint. Production will move smoother and faster. Good housekeeping will help hurry along that happy day—good housekeeping furthered by the use of Lusol in your machine tools.

REDUCE ABSENTEEISM . . . Lusol won't irritate workers' skin; it's as safe as soap. Lusol doesn't smoke, even under extreme pressure on high-speed cutting operations; there's less likelihood of head colds and the general atmosphere is brighter. There's nothing about Lusol, in a machine that's kept clean, to cause disagreeable odors.

BOOST EFFICIENCY . . . Workers like the neatness of shops where Lusol is employed. Machines kept clean and served by this all-chemical metal-working solution don't gum up; Lusol actually removes old sludge. Floors stay cleaner; Lusol isn't oily, so you don't have the expense of non-slip compounds. Wives of workers newly introduced to Lusol have been known to say, "You must have a new job; your clothes stay so clean now."

SPEED PRODUCTION . . . Lusol's more rapid cooling permits much higher speed machining. The less frequent tool grinding and fewer grinding wheel dressings required, the elimination of degreasing operations, all contribute to faster output by men and machines. Your costs are lower because production is higher.

THIS FREE BOOK

. . . gives case histories supporting the above statements. It also tells you how to clean machines and put Lusol to work in them. For a copy, write F. E. Anderson Oil Company, Inc., Box 213-K, Portland, Connecticut.

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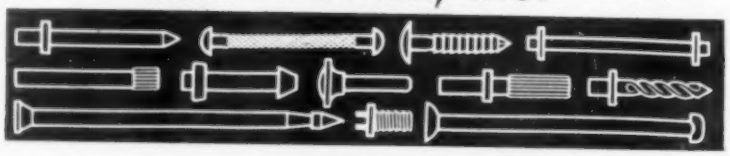

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NEW FIRM TO TURN OUT NONCIRCULAR GEARS

What is believed to be the world first private business wholly devoted t the design and manufacture of noi circular gears, has been established b Fred W. Cunningham. Base of the bus ness is the automation by Dr. Cunning ham, of a standard gear shaper no being operated by a motion picture film Purpose of the business is to provid engineering and manufacturing help t any who need such services in connec tion with noncircular gears.

According to the founder, the demand for such a facility has been greatly magnified in recent years by the urgency for more efficient war material. Noncircular gears in the past have been avoided by equipment designers due to six months and longer having been required to get the steel masters and special fixtures which were necessary to the cutting of such gears by past methods. Today the less efficient substitutes which have been used cannot be tolerated in rangefinders and many other instruments. Now, too, substitutions are unnecessary since fast, accurate, automatic means have been devised to eliminate need for metal masters as a preliminary step in production of noncircular gears.

Dr. Cunningham (Sc. D.) is a resident consultant to Arma Corp., Garden City and Brooklyn, N. Y., subsidiary of American Bosch Corp., and continues in that capacity. He is widely known particularly for his work in automating a variety of defense systems and in automatic spectrophotometry for precise color measurement.

New business will be conducted at 56 Hubbard Avenue, Stamford, Conn.

ITALIAN MANUFACTURER OPENS BRANCH IN STATES

One of the best known in this country of the Italian manufacturers of machine tools, the Macchine Industriali Soc. Acc., makers of the Cervinia line, has recently opened a branch office in New York. Address of the firm is Misal Machinery, Inc., 1 E. 53rd St.

According to the announcement, the firm will sell to dealers and distributors in the United States, and, in addition, the branch will be a source for service men for the equipment, who have been trained in their own factories.

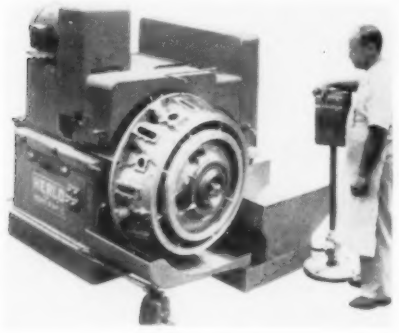
MEEHANITE MOVES

The Meehanite Metal Corp. announces recent purchase of a building at 714 North Ave., New Rochelle, N. Y., and is now installed in these new headquarters. In addition to complete offices, the building includes enlarged laboratory facilities for experimental melting, chemical and physical testing and photomicrographic studies.

Tools of Today . . . .

Boring Machine

This machine is a No. 3 Way-Type unit with a vertical indexing eight-station fixture. The low mounting position of the fixture on the way unit facilitates the handling of a heavy awkward part. Indexing is hand-operated with location controlled by an air-operated locator pin actuated by a foot valve.



Tooling mounted on a No. 218 boring-head includes cross feed unit. In-stroke operations consist of turning and plunging a chamfer. The table hits a positive stop and the cross feed operates with tools forming and blending two radii and generating a face.

Forty individual borizing operations are performed on each part with a total cycle time, including loading and unloading, of 12 minutes per part.

The table is interlocked with the cross feed unit so that it will not start the out-stroke until all tools on cross feed are clear of work. Also, the table is interlocked with the fixture so that the cycle cannot be started until the part is properly indexed.

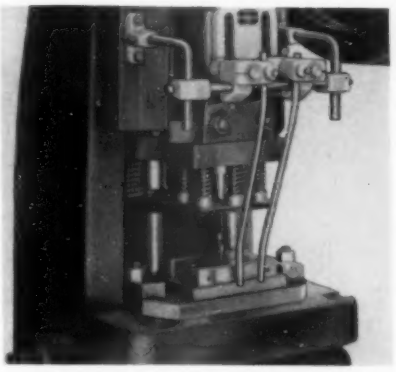
A pedestal push-button control panel allows the operator to control the machine at a point close to the loading station. Cycle is completely automatic after the Table In button is depressed.

Made by the Heald Machine Co., Worcester 6, Mass. **T-4-1231**

Press Sweep Guard

This safety guard for forming and secondary operations on power presses has up to a four-inch stroke. The simplicity of design of the guard and its positive action will convert any press within this range from a dangerous machine into a safe one, according to the manufacturer.

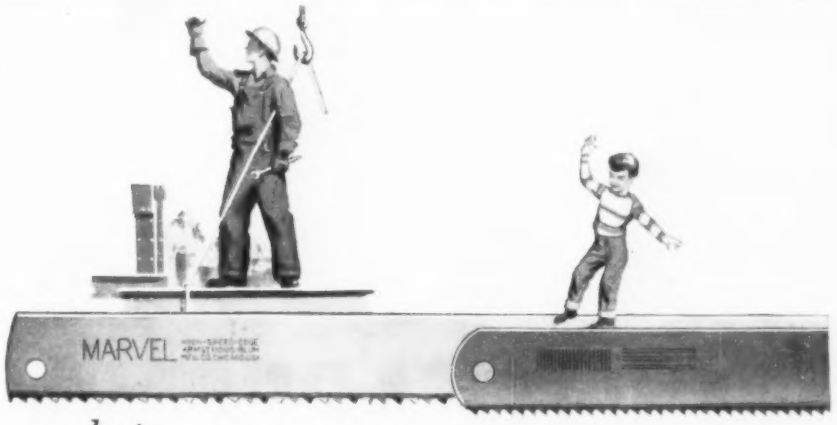
Actuated by the press ram, two guard arms with a sweeping motion push the operator's hands safely away



from the danger area as the ram starts to descend. So natural is this motion that protection is positive, increasing the confidence of the operator and allowing full concentration upon production.

The operator's field of vision is unobstructed by the two guard arms which may be arranged in a variety of ways to suit specific applications. They can be formed so as to sweep directly over the lower die or to guard the front, the back, or the side of the die, or a combination of these positions.

Features of this press guard are simplicity, ease of installation, needle bearings to insure long life, rugged construction throughout and positive safety for the operator. Made by Cooper Weymouth, Inc., 277 Noble Ave., Bridgeport 8, Conn. **T-4-1232**



. . . *but*

Experience Cannot be Copied

More than a quarter-century ago MARVEL invented and basically patented the MARVEL High-Speed-Edge Hack Saw Blade—the UNBREAKABLE blade that increased hack sawing efficiency many-fold.

Every MARVEL Hack Saw Blade ever sold has been of that basic welded high-speed-edge construction, with constant improvements from year to year, as EXPERIENCE augmented the "know-how" . . .

MARVEL is not "tied" to any single source of steel supply, and has always used the best high speed steels that became available from time to time as metallurgy progressed. When-as-and-if finer steels are developed—and are proven commercially practical for welded-edge hack saw blades—MARVEL will use them, regardless of cost or source . . .

There is only one genuine MARVEL High-Speed-Edge! All other "composite" or "welded-edge" hack saw blades are merely flattering attempts to imitate—without the "know-how" of MARVEL EXPERIENCE . . .

Insist upon *genuine* MARVEL High-Speed-Edge when buying hack saw blades—and be SAFE, for you can depend upon MARVEL. They have been "tested", "pre-tested", and "re-tested" by thousands of users for more than a quarter-century!

MARVEL *Metal Cutting* SAWS

Better Machines—Better Blades

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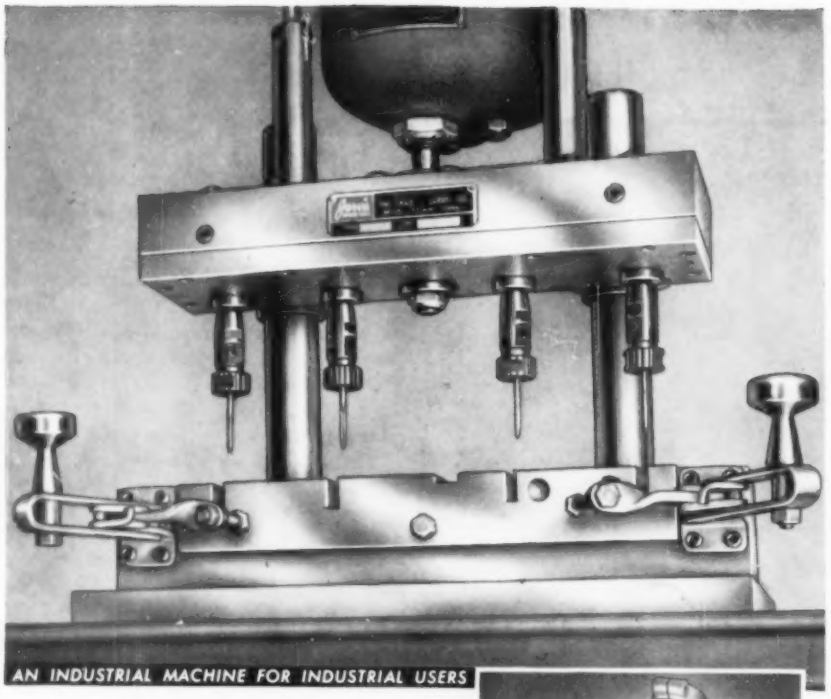
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-123



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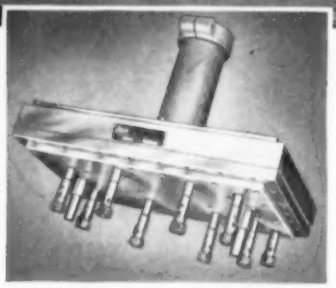
MULTI-TAPPERS



Engineered and built to your specific production requirements from our basic standard components, Jarvis Multi-Tappers can be furnished for any type of drill press available.

We invite your inquiries—let us assist in analyzing your tapping and drilling needs!

Send for our catalog featuring Jarvis Multi-tappers

NEW FEATURES OF JARVIS MULTI-TAPPERS

include:

- Aluminum case—Jig bored.
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WHEN POWERED WITH A JARVIS TORQOMATIC DRIVE THE JARVIS MULTI-TAPPER PROVIDES THE MOST EFFICIENT AND PRODUCTIVE MACHINE IN THE FIELD.

THE CHARLES L. JARVIS CO., MIDDLETOWN IN CONNECTICUT

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Saw Blade Welder

A larger capacity portable band saw blade welder has been announced by Brennen Mfg. Co., 676 59th St., Brooklyn 20. Designed to butt-weld all blades from $\frac{1}{16}$ to $\frac{3}{4}$ inch, it permits a wide range of work from intricate internal tool and die to power cutoff saws.

The band saw blade welder will handle practically all requirements of the band saw user. Its welding facility for all types of band saw blades reduces filing time, because it cuts close to the line. Complete instructions are printed on the name plate and simplified controls assure uniform results.

There is a built-in grinder designed to remove flash from the weld, and a double gage for checking thickness of weld on flat saws. Because of its portability, it is possible to service a battery of band saws with the welder. However, the removable back plate facilities permit permanent installation when desired.

Welding jaws are constructed of solid copper and the unit is housed in a welded steel case with gray wrinkle finish. Dimensions of the Brennen welder are 7¾x12x7 inches. Weight is 31 lb. The welder operates on 110 volts a-c, 60 cycles, and has an 8-ft. cord and plug. **T-4-1241**

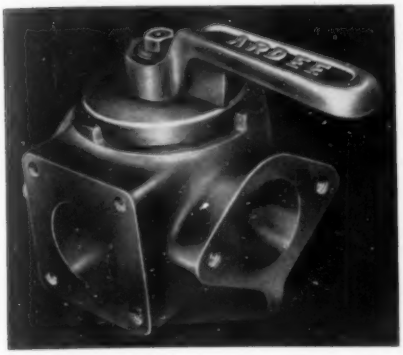
Diamond Wheels

A line of Star Dust diamond wheels and hones is announced by Ace Abrasive Laboratories, 250 West 57th St., New York 19. A specially developed bonding method gives the wheels maximum efficiency, according to the company. The bond is hard enough to hold the abrasive properly, yet dissipates at a rate calculated to keep the abrasive surface always even. The diamond wheels and hones come in all types and sizes. **T-4-1242**

Recirculating Valve

A recirculating valve that may be used for any stream dividing application of gases, air, salt water, oil and mild chemicals to 125 psi is now in production.

The design incorporates a combination of plug valve principles and O-ring sealing. It is claimed that a positive leakproof condition is obtained and that handle loads and internal wear are reduced to a minimum by the use of an externally adjustable spring seating control featuring multiple ball pressure contact against a hardened wear ring.



The manufacturer reports recent tests indicate minimum pressure drop and full pipe orifice flow characteristics in the 2-inch size now being produced.

The valve is available in cast aluminum, steel or Navy bronze. Bronze and steel valves are cadmium plated throughout. Flange connections are available for either male or female thread adaptation.

For information write Ardee Mfg. Co., 840 North Seward St., Los Angeles 38. **T-4-1251**

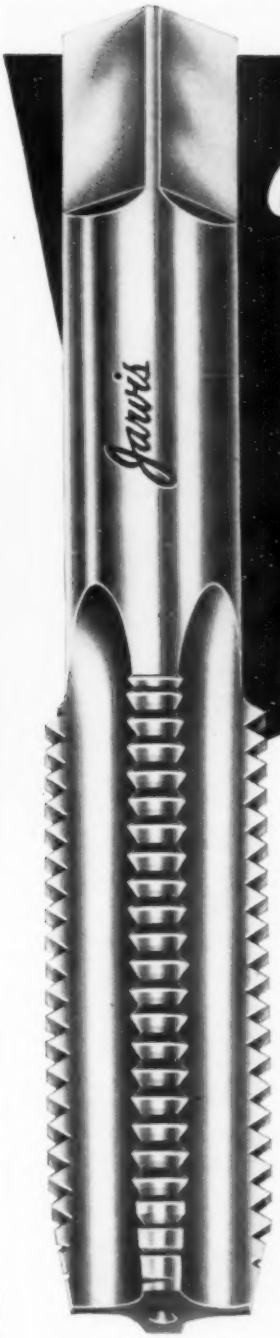
Rosin Core Solder

A rosin core solder, active yet noncorrosive, has been developed by Federated Metals Div., American Smelting and Refining Co., New York. Tests show that the spread of RTS 200 solder is 30 percent greater than that of conventional rosin core solders, according to the company. Oxide films and corrosion products on the parts being soldered need not slow down operations, because this solder pierces such retarding agents faster than ordinary solders.

Despite the activity of the RTS 200 flux at soldering temperature, there is no harmful corrosion residue when tested under the high humidity conditions of military specification MIL-S-6872. The flux in the solder is just as active after standing for long periods as when used immediately.

The chemicals used in the rosin core solder have no toxicity factor.

T-4-1252



Jarvis TAPS

AN INDUSTRIAL TAP FOR INDUSTRIAL USERS

have "Custom Made" Cutting Edges at NO EXTRA CHARGE

"Custom Made" means just that! Accurate indexing and precision machine grinding of flute and spiral points on Jarvis Taps produce a tool in which ALL the cutting edges do their share of the work. Our highly accurate fluting process makes it possible for us to control for your PARTICULAR NEEDS the amount of hook ground in the flutes. Specify Jarvis, and you'll always have "Custom Made" Taps designed to do a specific job superbly well.

JARVIS POWER TOOLS include:

TAPPING ATTACHMENTS
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Send for complete Tap Catalog now—also name of your nearest Jarvis representative.

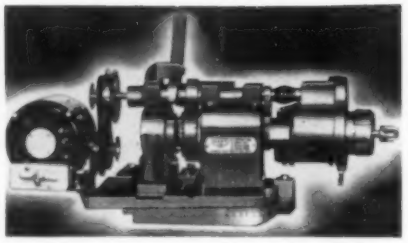
THE CHARLES L. JARVIS CO., MIDDLETOWN IN CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-125

Grinding Attachment

The motor-driven Circularity grinding attachment simultaneously revolves the work to be ground and moves it longitudinally back and forth. This simultaneous operation is the result of direct gear drive from drive shaft to collet housing gear and spacer gear.

Standard spacer gears with a follower pin for each flute to be ground provide indexing for 2, 3, 4, 6, 8, or 12 flutes. Special spacer gears can be provided when numbers of flutes are other than those listed. The number of



back and forth movements per revolution of work is controlled by number of follower pins used in spacer gear.

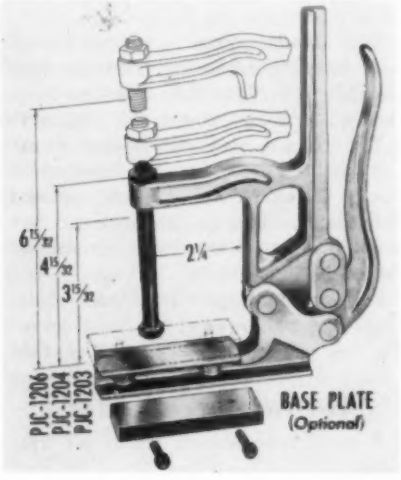
Simple setups on this attachment permit fast and easy grinding of form relief, radial relief, form and radial relief together, tapered cylindrical and straight cylindrical. Cutting tool to be produced or reworked is held in collet or between dead centers and revolves on its own axial center. Where full length of spiral cutting tools is to be ground for both form and radial relief, the Circularity grinding attachment travel is similar to an OD grinder, which insures fine finish, back taper and accurate size.

Literature is available from Detroit Reamer & Tool Co., 2830 E. Seven Mile Road, Detroit. **T-4-1261**

Toggle Clamps

Many arrangements for the clamping spindle are offered in the Knu-Vise line of toggle clamps manufactured by Lapeer Mfg. Co., Lapeer, Mich.

The most universal arrangement for the clamping spindle is provided by clamps with the channel bar. These clamps readily permit the location of the spindle any place along the bar. No brazing or welding is needed. The force of the spindle is at 90 deg to the channel bar.



When the clamping force is required to be at an angle to the channel bar, the spindle is installed in a bolt bushing which is brazed or welded at the required angle any place between the two members of the channel bar.

For angular clamping with lighter forces, smaller clamps are available with the closed bar. For these clamps the spindle is installed in a bolt retainer which is brazed or welded at the required angle on the closed bar. The closed bar may be cut shorter if necessary. In any installation the spindle also is adjustable for clamping height. **T-4-1262**

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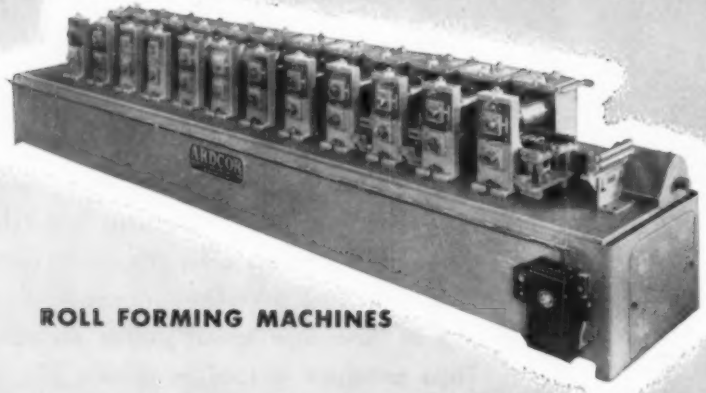
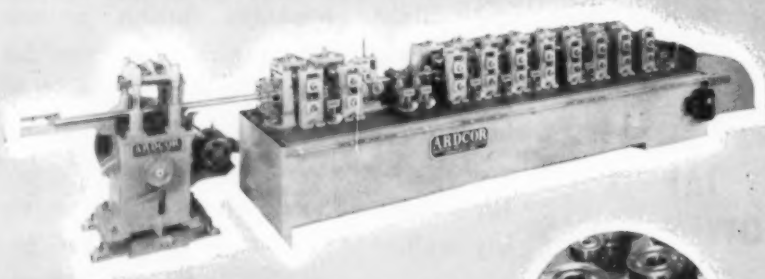


ROLL FORMING MACHINES

PUNCH TYPE CUT-OFFS LOCK SEAM TUBE MILLS



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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-126

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Lathe Chuck

An addition to the line of lathe chucks made by Westcott Chuck Co., Oneida, N. Y., is the No. 5909 8 inch 3-jaw independent chuck, threaded 2¼ inches-8 for direct mounting on lathes, milling machines, grinders, and other machine tools with 2¼ inch-8 spindles.

No adapter is required and the chuck is therefore mounted close to the spindle bearing. This close mounting minimizes chatter that might be caused by excessive overhang.

Compared with other chucks of the same diameter, total overhang, when mounted on a 2¼ inch-8 thread spindle, is approximately ½ inch less. This reduction is possible not only because of the close-up mounting, but also because the chuck body is only 2⅛ inches thick.

The body is semisteel. Jaws are steel, heat-treated and ground. Screws are alloy steel, heat-treated. They are threaded their full length except where necked for bearing. Thrust bearings are steel, heat-treated and fitted tightly into the chuck body. An operating wrench is included with each chuck. Net weight of chuck is 19 lb; body thickness, 2⅛ inches; center hole diameter, 1⅞ inches. **T-4-1271**

Bed Turret

A self-indexing bed turret has been announced by A. K. Tool Co. The Tilthead design makes it practical to swing tools as large as 6 inches in diameter over the ram and also gives working travel of 7¼ inches.

A wider variety of tooling can be used with the Newton turret because it features greater tool clearance for large tools. Yet, with this extra clearance, tools are always in alignment with the spindle on the working stroke. This self-indexing bed turret has ground bearing surfaces on the slide and bed plus selective fitting of key parts. Repeating accuracy is assured by a new type tapered locating pin which works in a sleeve bearing, and locates in a mating seat. All parts are made of tool steel heat-treated to tool bit hardness, ground and honed for a superior fit.

The long working stroke with a short minimum index stroke is a feature. Through a clutch arrangement, indexing can be either manual or automatic. For extra heavy cuts where extreme rigidity is desirable, the ram lock and head lock give the stability needed. The turret is designed for most 10, 11, and 12 inch lathes. For further details write A. K. Tool Co., 2029 Blake Ave., Los Angeles 39. **T-4-1272**

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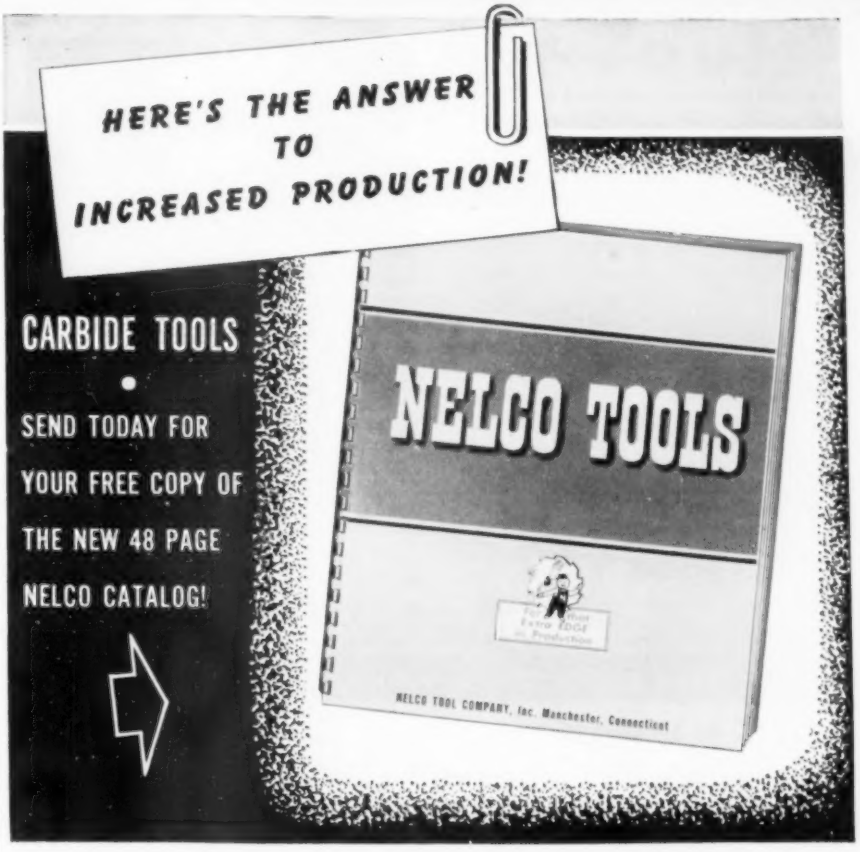
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SEND TODAY FOR YOUR FREE COPY OF THE NEW 48 PAGE NELCO CATALOG!
NELCO TOOLS
NELCO TOOL COMPANY, Inc. Manchester, Connecticut

Get the graphic story. . . . Nelco carbide tools assure faster, better, more profitable production.

Nelco Tool versatility—actually your assurance of *special tools at standard prices*—is shown in the nearly 800 carbide cutters Nelco regularly maintains in stock. In the Nelco line of 4 flute end mills alone, there are available 63 standard cutters in diameters from ⅜" to 2".

Diamond-hard carbide swiftly chews through the toughest metals—works to closer tolerances and leaves finer finishes than conventional cutters. Higher table feeds mean MORE production. Costly down time is slashed! Nelco tools stay sharper longer—mill more pieces per grind. Nickel shim brazed carbide tips on alloy steel bodies mean year after year of service free operation.

Nelco SERVICE extends directly into your plant! An experienced Nelco field engineer will be glad to discuss, suggest, troubleshoot *in your plant, on your machines.*

Unusual, out of the ordinary tools described in this catalog can be designed or built to your specifications by Nelco carbide technicians.

NELCO TOOLS For that Extra EDGE in Production

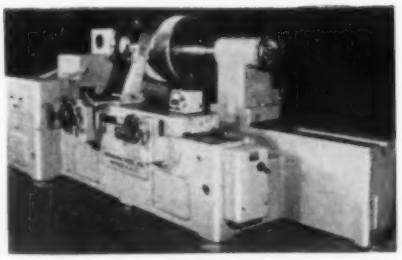
NELCO TOOL COMPANY, INC., MANCHESTER, CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-127

Gear Checker

Designed to check both lead and axial pitch on large helical or herringbone gears, as well as parallelism of teeth on large spur gears, Michigan Tool Co., 7171 E. McNichols Rd., Detroit 12, announces the Sine-Line model 1248 lead checker, said to be the word's largest.

The Sine-Line lead checker will check both lead and axial pitch on gears from 18 to 48 inches outside diameter, with a maximum face width of 25 inches and a maximum shaft length of 96 inches. Either right hand or left hand leads may be checked. The machine uses the sine bar principle to check leads from 0 to 80 inches. Either manual or power drive is used in its operation. No change in the mounting of the gear is required to check either lead or axial pitch. Gears of varying face widths or diameters, but with the same lead, may



be checked without changing the setting of the sine bar.

The machine has a massive cast base for rigidity. The machine consists primarily of two tables, a transverse table carrying the sine bar, enclosed in the left of the machine, and a longitudinal table which carries the indicator. The sine bar table is arranged to move crossways at the same time the indicator table moves lengthwise, parallel to the axis of the gear being checked. The sine bar table, when moved back and forth, rotates the spindle upon which the gear is mounted. The adjustable sine bar determines the relationship between the movement of the indicator table and the rotation of the gear being checked. Correct adjustment of the sine bar is determined by a simple formula. **T-4-1281**

Flow Control Valve

For metering or controlling the oil flow in a hydraulic system, a multi-range flow control valve has been announced by The Denison Engineering Co., Columbus, Ohio. It is designed for operating pressures up to 3000 psi and offered in 2-port and 3-port types in ¼, ⅜, and ¾-inch sizes for subplate mounting. It is also available with or without built-in checks.

Being of the pressure compensating type control, oil flow can be maintained at a uniform rate regardless of circuit pressure variation, insuring smoother operation and freedom from erratic motion.

Featuring a 2-way adjustable orifice, it provides not only 100 percent regulation of flow within a given range but also an optional choice of ranges to accommodate low or high volume systems. In addition to being adjustable in length the width of the orifice also can be varied by turning the entire control stem upward or downward. A knurled dial adjustment locking screw limits each range of control. To change the range the screw is turned outward, releasing the spool. The single cartridge type spool may then be rotated in increments of 180 degrees until the desired maximum range of flow is reached. Thus, should the flow requirements of a circuit change, the orifice may be adjusted to control a lesser or greater delivery and still provide a 100 percent scale adjustment of the selected volume.

This multi-range flow control can be used in meter-in, bleed-off or other standard circuits used in a work cycle.

For further information, write The Denison Engineering Co., 1160 Dublin Road, Columbus 16. **T-4-1282**

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Wet Blasting Machine

This redesigned liquid abrasive blasting machine is intended to clean, finish, burr, blend or etch a wide variety of dies, molds, tools and other parts. The liquid slurry is drawn up by siphon injection and propelled from the blasting nozzle by means of a high velocity air stream. The only moving part within the cabinet is the blower which is used to ventilate the cabinet.

The Jet Blast machine is designed to handle abrasives ranging from 60 to 5000 standard screen size, and fast change-over of abrasive slurry is possible. A reversible pump located beneath the cabinet effects complete change in less than 5 minutes. A special method of maintaining the slurry in suspension permits higher concentration of abrasive at the point of work and thereby increases speed of operation.

Size of abrasive particles, concentration of abrasives in solution, the distance between nozzle and work, and the supply air pressure can be varied to produce the results desired. The Jet Blast machine handles the most delicate cleaning problems without surface damage or dimensional alterations. It is particularly effective in removing rust, scale and other deposits, and the clean matte surface which it produces increases adherence of paint, porcelain, rubber or electroplated metals. It can effect any desired finish on any flat or irregular surface. Sharp edges are retained, and metal removal can be held to 0.0001 inch. This machine can be used for light burring, honing cutting faces, and for blending or removing directional grinding lines or tool marks on machined surfaces in order to reduce possible fatigue failure. Made by R. W. Renton Co., 748 Addison Rd., Cleveland 3. **T-4-1291**

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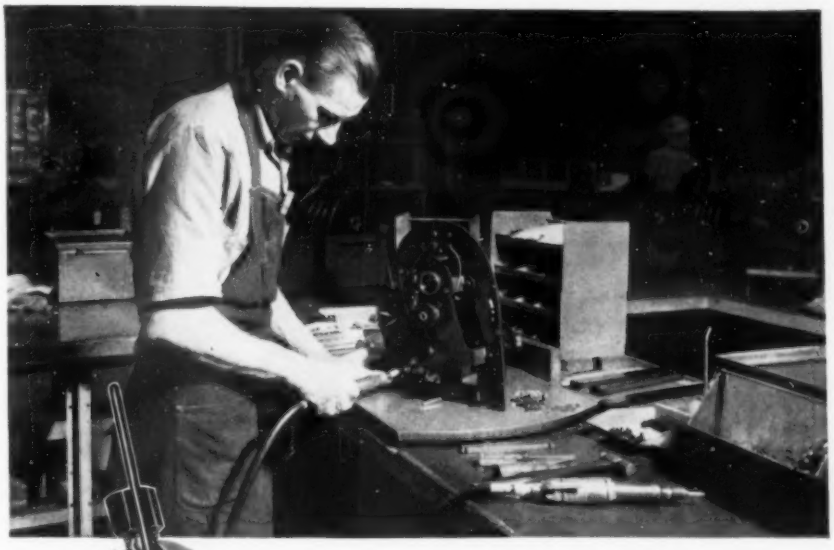
KELLER Air Tools

Increase Production per Man-Hour



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KELLER *Air Tools engineered to industry*

Keller Screw Drivers and Nut Setters brought important benefits to a manufacturer of duplicating machines. He says: "Since we started using Keller air tools there has been a noticeable reduction in worker fatigue, and increased production per man-hour.

"Our work requires highly skilled, intelligent workers, and these tools have given them better satisfaction in their jobs, and improved our labor relations."

Weigh less

Consume less air

Reduce operator fatigue

Wide variety of handles, gearings, torques, speeds

Interchangeable parts

Need fewer "back-up" parts in the tool room

Clutches, socket drivers, 45° and 90° attachments for every purpose

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WERNER

#5 and #6 VERTICAL MILLERS

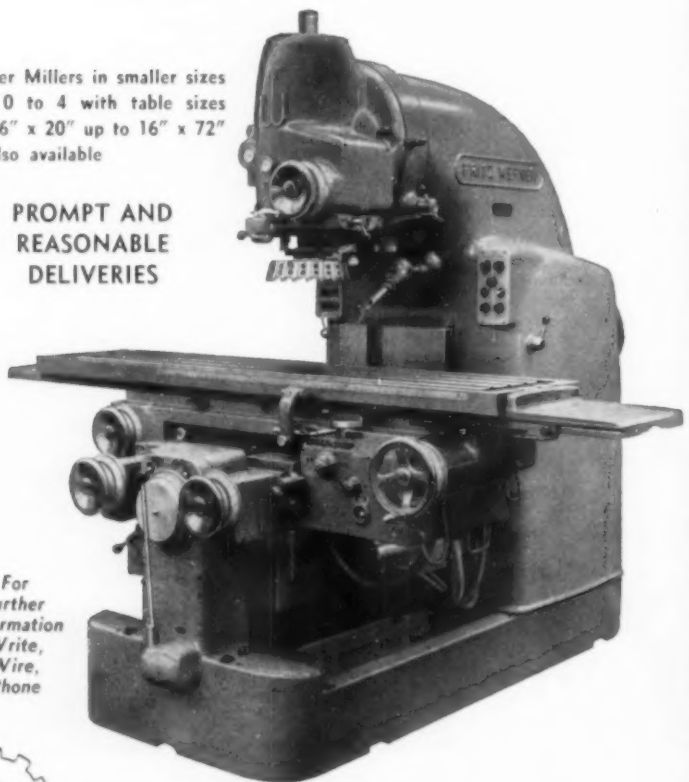
#5 Table 20" x 90" **#6 Table 20" x 110"**

Both are equipped with a 40 H. P. or an optional 50 H. P. motor for the spindle drive.

Spindle speeds range from 16 R.P.M. to 1800 R.P.M. Feeds range from 9/32" per minute to 80" per minute

Werner Millers in smaller sizes from 0 to 4 with table sizes from 6" x 20" up to 16" x 72" are also available

PROMPT AND REASONABLE DELIVERIES



For further information Write, Wire, Phone

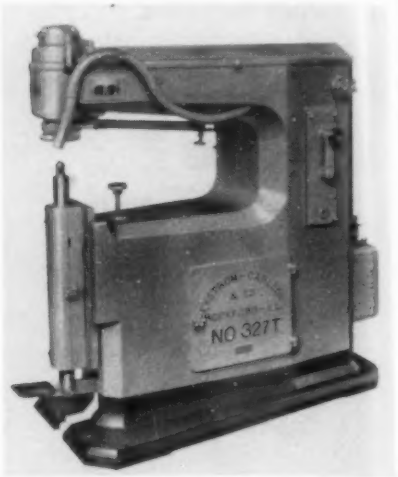
MARAC machinery Corp.

1819 BROADWAY, NEW YORK 23 • CI 7-2048

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-130

Trim Router

This No. 327-T trim router is suited for trim routing large and difficult to handle nonferrous sections. Either of two spindle speeds, 10,000 and 20,000 rpm, is easily obtained with a selector lever and a simple belt change, and 3, 5 or 7½-hp spindle drive motors at 3500 rpm are optional.



Physical dimensions of this machine include a 27¾-inch throat clearance and a floor to guide pin holder height of 32¾ inches. The adjustable distance from the end of the guide pin holder to the face of the spindle ranges from a 3-inch minimum to a maximum 9¼ inches. Spring-loaded, sliding guide pin holder provides a 6¼-inch maximum stroke, controlled by means of an adjustable, screw-type stop.

For additional information write to Dept. M-17, Ekstrom, Carlson & Co., 1400 Railroad Ave., Rockford, Ill.

T-4-1301

Tube End

A tube end reducer, as an addition to its line of tube fittings, is announced by the Parker Appliance Co., Cleveland.

The reducer is used to convert any Ferulok fitting into a combination size unit, permitting connection of a smaller size tube as is often necessary in certain tubing system installations.

The reducer is inserted into the tube connection end of the regular fitting and attached with the nut and ferrule of that fitting. The other end of the reducer is coupled to the smaller size tubing with the reducer's nut and ferrule.

The reducer is available for all commonly used reductions within the Ferulok size range of ¼ through 1 inch outside diameter tubing. Ferulok fittings are suitable for heavy wall tubing which may be required because of high pressure or severe vibration conditions.

T-4-1302

New!

KOEBELITE
TRADE · MARK

Cemented Diamond Particles

More efficient than conventional single diamond tools —with MUCH LONGER LIFE.

•

Reduces set-up time—increases production.

•

Now ready and proven: Koebelite CDP (Cemented Diamond Particles) Tool for Ex-Cell-O and J & L Thread Grinders, pictured above.

•

KOEBEL DIAMOND TOOL COMPANY

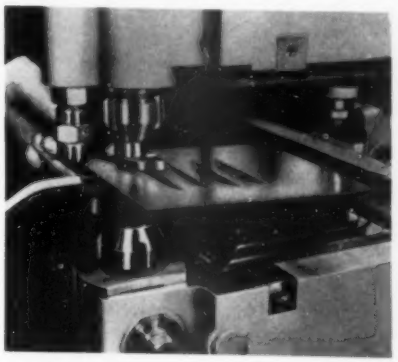
9456 GRINNELL AVENUE
DETROIT 13, MICH.

FIRST to give diamond users the advantage of diamonds set in powdered metal.

INDICATE A-4-131-1

Louvering Tool

The American Pullmax Co., Inc. has announced a set of specialized tools for the Pullmax sheet and plate working machines designed to cut louvers in steel and nonferrous metals.



This attachment permits the cutting and forming of louvers in a single operation. Although the radius and opening of the louver remain constant, it may be cut to any length. The attachment has a swinging type of female die in the lower section which can be moved to either right or left for the final end forming of the louver.

For literature on the louvering tools write American Pullmax Company, Inc., 2455 North Sheffield Ave., Chicago 14.

T-4-1311

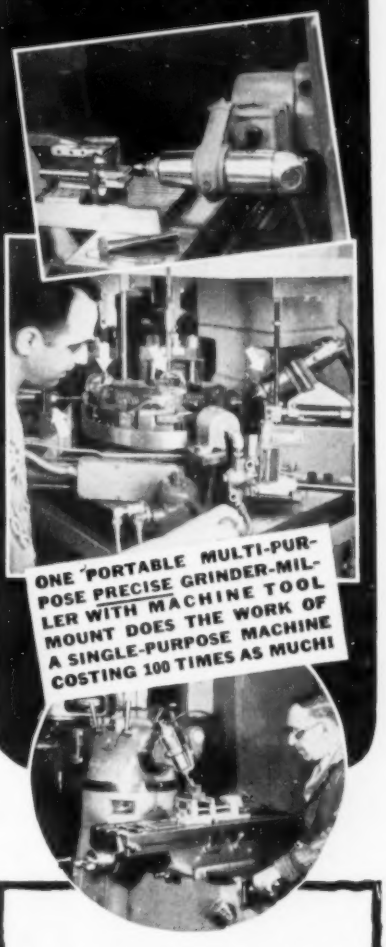
Electric Boiler

A line of electrically operated steam generators utilizing new electric boiler design is announced by Livingstone Engineering Co., 100 Grove St., Worcester, Mass. The electrode steam generator, unlike those utilizing resistance heating elements, can be designed to operate on various voltages at constant amperage, so that the rating, heating capacity and steam output vary in direct proportion to the voltage. Utilizing this principle, these Speedylectric boilers are designed for 220, 440 or 550v but they offer advantages to those purchasers who have or can make available 440 or 550v power supply. Speedylectric series ABC steam generators operating on 440v require less than one-half the floor space per boiler hp, approximately one-third to one-half of the floor space required for conventional fuel fired boilers in a comparable capacity range. The boilers operate at 98 percent efficiency with unity power factor and they are entirely free from low water danger and fire hazards. There are no tubes to scale or burn out, no feed water treatment is required, nor is a daily blow-down. The ABC boilers are offered in standard sizes up to 60 bhp and pressures up to 500 psi.

T-4-1312

LOWEST COST PRECISION

FOR TOOL ROOM AND PRODUCTION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PRECISE PRODUCTS CORPORATION
1314 CLARK ST. • RACINE, WIS.

Precise

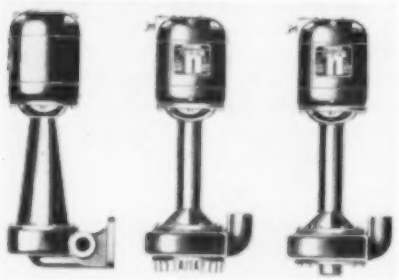
GRINDER-MILLERS

INDICATE A-4-131-2

Centrifugal Pumps

Three centrifugal pumps, models VBH, VD and VE, have been added to its line by Pioneer Pump, Division of Detroit Harvester Co., 19657 John R Street, Detroit 3.

Suitable for pumping practically all types of liquids not too viscous or too corrosive for modern corrosion-resistant alloys, the pumps offer ready adaptability to both continuous and intermittent pumping operations in numerous industries. Each model is available in sizes from 1/20 to 5 hp, with several different port styles and mounting brackets. Larger sizes are rated at up



to 148 gpm at free flow and 9 gpm at 124.7 ft. of head (54 psi) based on water at 60 F.

A useful feature is the provision of a separate intake bracket and support column, permitting removal of motor and column for easier maintenance without disconnecting the intake bracket and discharge piping from equipment.

All three models are sealless type pumps and have no pump bearings, seals or other moving metal-to-metal parts to wear. They are particularly suited for handling liquids that are highly polluted with abrasives, chips and other entrained solids.

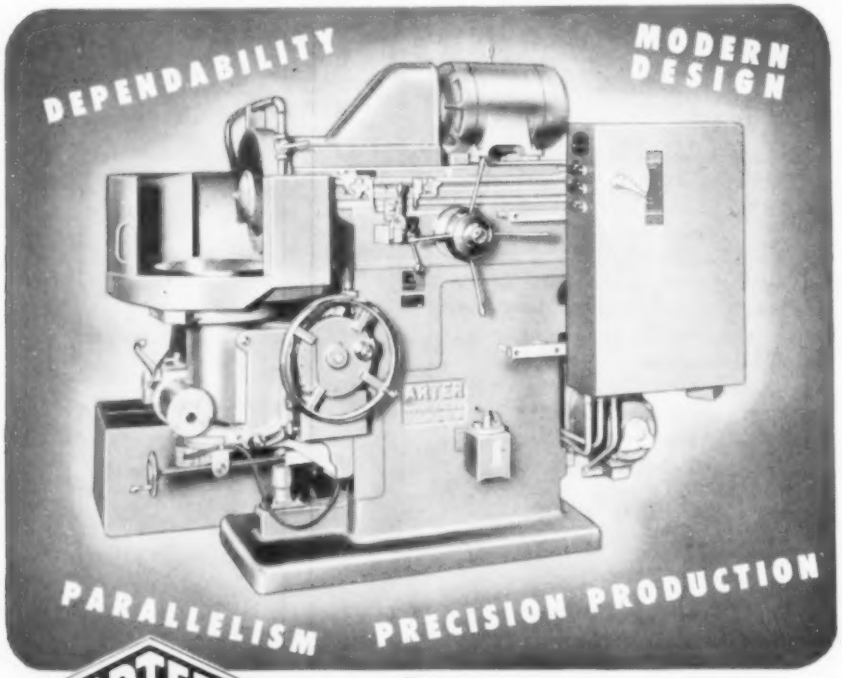
Of particular advantage for intermittent operation, the pumps are designed so that increasing the effective head proportionately reduces power demand. When the discharge line is closed, for instance, power demand drops to a point just sufficient to overcome hydraulic friction of the impeller. To avoid possible overload in the event of a sudden decrease in operating head, each pump is powered for the lowest possible head attainable with the discharge fully open. These features have the additional advantage of eliminating the need for relief valves of by-pass valves in the delivery line. **T-4-1321**

Portable Vacuum Unit

Mounted on a fabricated steel base, this unit, announced by the F. J. Stokes Machine Co., Philadelphia, can be transported by truck, fork truck or crane to any point where there is a need for a vacuum system. It can be used as emergency equipment for the vacuum processing of a product or production materials or to test pipelines, vacuum and storage chambers, pumps and other equipment that must be vacuum-tight.

This pump wagon is available in two models, the smaller handling more than 2000 cfm between 1 and 10 microns absolute pressure, the larger more than 4000 cfm between 1 and 10 microns absolute pressure. The 2000 cfm model, 147-E-10, consists of one Microvac pump, one diffusion pump, one high vacuum valve, one ½-hp hermetically sealed refrigeration unit with baffled cold trap coil. All auxiliary piping and valves and electrical controls are also mounted on the unit's common base. Connection for purchaser's manifold is the standard 10-inch pipe flange having a center line 42 inches above the floor. The steel base is equipped with self-locking leveling jacks.

For the roughing stage in vacuum operations, the 115-cfm mechanical pump provides rapid pull-down. For intermediate pressures, the diffusion pump's broad range obviates the necessity of a booster pump. In the lowest ranges, the almost double capacity of the diffusion pump is protection for extra loads such as imposed at this point by outgassing. **T-4-1322**



Rotary SURFACE GRINDERS

Model D • 12" and 16"

Arter has been building Rotary Surface Grinders for more than thirty years. The Model D machines are an intermediate series, 12" and 16" in diametrical capacity. They are modern in design, dependable and built to give years of satisfactory service to all users of this type of precision grinder.

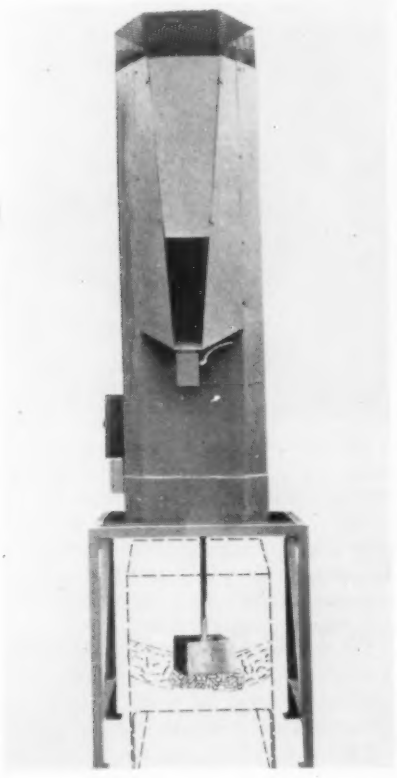
Write today for complete details and specifications.

Arter GRINDING MACHINE CO.
WORCESTER 5, MASSACHUSETTS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-132

Parts Elevator

An automatic elevator for handling small parts magnetically is called the Magnavator. Made by Prab Conveyors, Inc., 19875 Mack Ave., Detroit 36, the device elevates such small parts as rivets, bolts, nuts, valve stems, piston rings, stampings, etc.



One or more Alnico permanent magnets are mounted in a nonmagnetic container. This container is suspended from a steel arm. The length of this arm varies to suit the depth of the container in which the parts are located.

A shaft runs the entire height of the Magnavator. On this shaft a nut reciprocates, elevated by a chain around a pulley. Two roller bearing cam followers guide the magnet assembly through its vertical and indexing motions. Parts are stripped from the magnet and fall by gravity.

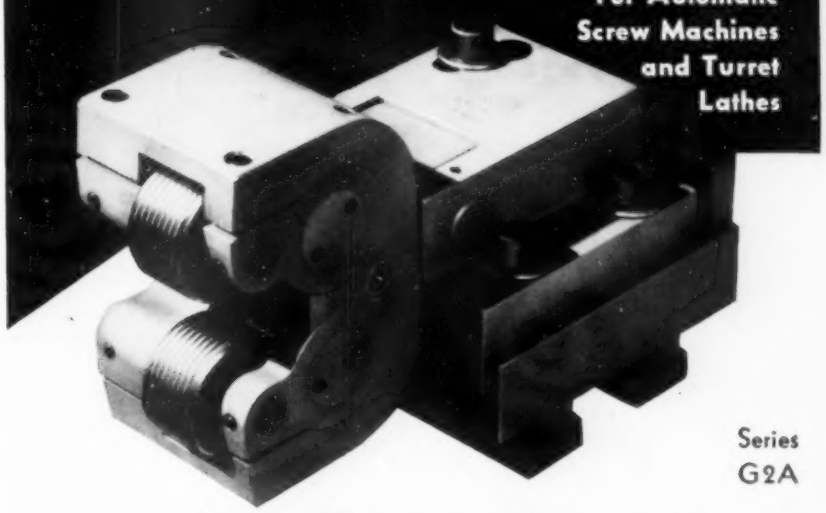
The selenium disk rectifiers convert the input ac to dc. The rectifier, fuses, relays and variable auto-transformer are housed in the control box with a push-bottom starter. A limit switch is incorporated which starts and stops the Magnavator according to the material in the feed chute. **T-4-1331**

USE READER SERVICE CARD ON PAGE 137 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

REED RID

Thread Rolling Attachments

For Automatic Screw Machines and Turret Lathes



Series G2A

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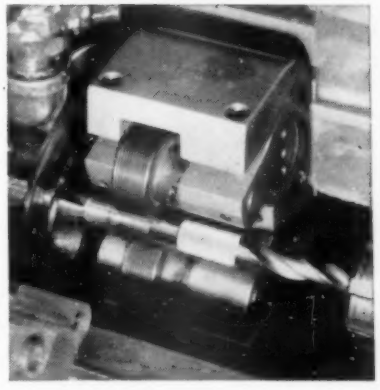

Reed attachments have two opposed rolls which pass over the work when rolling the thread. They are easy to set up and rolls may be quickly changed and adjusted for size. A simple device provides for precise matching of the rolls.

Thread rolling is accepted as an economical and preferred method of producing smooth precision threads on automatic screw machines and turret lathes at high production rates. It permits threading close to shoulders and since rolling can be done on the collet end of the part behind shoulders, a secondary threading operation is often eliminated.

The series G2A Reed Thread Rolling Attachments are multi-purpose tools currently built in four popular standard sizes. Each attachment will accommodate an unlimited range of diameters within its capacity—only a single attachment is required for rolling all diameters within the size range. Straight or taper threads may be accurately rolled whether they are right or left hand or have multiple leads.

Send us specifications of your requirements and let us supply you with complete information.

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This T-J Cutter at work on a connecting-rod die block for a board drop hammer. A cutter of right design and heat treatment for this high speed work in tough die steels, making possible maximum efficiency of these machines.

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You can raise the feed . . . they're *extra sturdy* for cutting tough die steels! Designed for speed, accuracy and long life . . . T-J Cutters hold a sharp edge longer on job after job . . . less breakage! Made from an extremely high grade steel . . . properly machined . . . scientifically heat-treated, accurately ground. Wide range of styles and sizes . . . *right* to increase the output of your machines and *reduce costs!* Send for new catalog 150. The Tomkins-Johnson Co., Jackson, Mich.

T-J FOR TOUGH JOBS

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DIE SINKING MILLING CUTTERS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-134

Hydraulic Presses

A line of hydraulic gap type presses for forcing and straightening operations is announced by the Dake Engine Co., Grand Haven, Mich. These presses are available in eleven standard forcing models and eleven standard straightening models with capacities ranging from 15 to 300 tons. They are electrically powered.

The straightening presses have a self-contained power unit, and adjustable stroke control for both directions of stroke. A combined hand and foot lever provides sensitivity which permits the operator to apply any pressure up to maximum by merely increasing pressure on the control valve.

The forcing presses have a two-speed ram advance and extra large table, permitting their use for a wide variety of operations. The stroke can be preset for both directions by an adjustable stroke limit cam. Semiautomatic or automatic cycling can be provided at slight extra cost. **T-4-1341**

Protractor

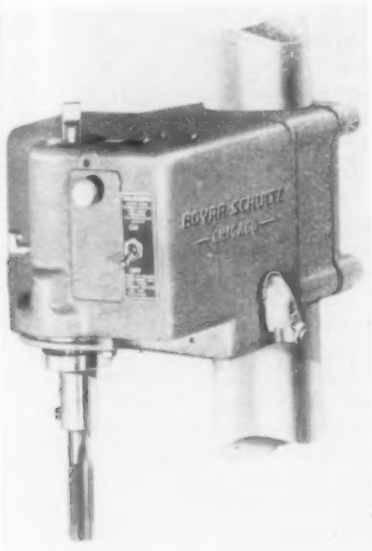
The model PRO protractor is a quadrant marked off in degrees from 0 to 135 in 5-degree steps. The protractor is attached to the tilt trunnion on the control side of a welding positioner where it is readily seen by the operator when tilting the table. Precise tilt angles are thus very easily obtained every time the table is tilted.

Welding research has shown that tilting the weld V downhill 10 degrees results in over 50 percent increase in the weld speed. The PRO protractor facilitates positioning the work for this 50 percent increase with assurance of welding in exactly the same attitude every time. The protractor also serves a useful purpose when setting up, and when testing new weld processes and techniques. Aronson Machine Co., Arcade, N. Y. **T-4-1342**

USE READER SERVICE CARD ON PAGE 137 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Lead Screw Tapping Head

With this tapping head it is possible to change an ordinary drill press into a precision tapping instrument in a matter of minutes. The attachment can produce any thread including class 4.



No special skill is required for operation; anyone familiar with a drill press can consistently produce accurate threads. A foot control switch leaves the hands free for loading work. A built-in reversing switch actuates the drill press motor, eliminating the need for any intermediate reversing device.

Long trouble-free life of bronze nut and ground lead screw is assured because of their 1¾-inch diameters. Extreme accuracy in control of tapped hole depth is assured by electrically controlled switches.

All taps up to ⅞-inch diameter are usable with standard adapter bushings. For taps from 15/16 to 2 inches, adapters are available on special order.

Made by Boyar-Schultz Corp., 2110 Walnut St., Chicago 12. **T-4-1351**

Special Tool

The patented prong-type tool called the Brammertool makes it much simpler to attach and detach V link belting. A light pressure inserts ends of prongs into standard slots of V links. Another easy twist opens up the slots so that rivet heads can be quickly slipped in or out to make or break connections in the belting. The Brammertool makes adjustments in a matter of seconds. It was developed by the Brammer Corp., 684 Broadway, New York 12. **T-4-1352**

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Division of Simonds Saw and Steel Co., Fitchburg, Mass. Other Simonds Companies: Simonds Steel Mills, Lockport, N. Y., Simonds Canada Saw Co., Ltd., Montreal, Que. and Simonds Canada Abrasive Co., Ltd., Arvida, Que.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-136

Flow Meters

These flow meters are for the indication of flow rates of air and industrial gases. Available in 11 different sizes, each meter has its own built-in calibration for the specific gas and rate of flow to be measured.

Measurements are easy to read since the oil in the glass tube not only dampens pulsations, but also prevents the accumulation of dirt or foreign matter that might obscure the reading. Each meter has but one moving part, and cleaning can be accomplished in less than two minutes without the use of tools.

The meters are designed for panel mounting. Thus, installation costs are minimized because piping can be simpler. If panels are not used, standard brackets are available for single, double or triple mounting.

A large tab affixed to the bottom of each meter indicates in large red letters the specific gas being measured.

Waukee Flo-meters are available for measuring dissociated ammonia, propane, exothermic cracked (rich), exothermic cracked (lean), air, natural gas, ammonia, butane, nitrogen, city gas, purging gas, carrier gas, hydrogen, oxygen, and endothermic gas.

Write for bulletin No. 201 to Waukee Engineering Co., 759 North Milwaukee St., Milwaukee 2. **T-4-1361**

Drawing Die Checker

The Ao-Elder Die Angle scope, an optical instrument especially designed for measuring entrance angles of wire drawing dies, has been announced by American Optical Co., Instrument Div., Buffalo 15.

This instrument has been developed and manufactured under license with Mr. Flint C. Elder, formerly Director of Research at American Steel and Wire Co.

It permits even unskilled operators, with only a few minutes' instruction, to read entrance angles to an accuracy of ± 10 minutes of arc. The die is not damaged in any way. Multiple angles and poor polish are obvious immediately. Every size of carbide wire drawing die can be measured accurately from the largest down to dies as small as 0.005 inches.

The new Die-Angle scope is the first practical shop instrument for checking die angles before they can affect wire quality. It permits more intelligent control of wire drawing processes, resulting in higher quality and reduced spoilage.

This instrument is compact, portable and simple to operate. It is sturdily constructed of light weight aluminum castings, with integral light source and transformer. **T-4-1362**

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TRADE LITERATURE CURRENTLY OFFERED BY THE TOOL ENGINEER ADVERTISERS

LITERATURE NUMBER	COMPANY	BULLETIN	DESCRIPTION
A-4-257	American Broach & Machine Co.	300	Catalog describes surface and internal broaching with American broaching machines.
A-4-149	B. C. Ames Co.	58	Catalog describes company's line of measuring instruments.
A-4-121	F. E. Anderson Oil Co.		Free book "Lusol Gets to the Point" tells how to increase feeds and speeds, guaranteeing longer tool life.
A-4-157	Anker-Holth Division, Wellman Engineering Co.		Bulletin describes complete line of company's power cylinders.
A-4-158	Armstrong Brothers Tool Co.	S-48	Added profits minus added tool costs with the "Armstrong system."
A-4-221	The Bellows Co.	CL-50	36-page booklet describes "Controlled Air-Power" for faster, safer production.
A-4-26	Besly-Welles Corp.		"Handbook for Tap Users" contains "Tap Tips" on tapping methods and selection.
A-4-213	Boston Gear Works.		Time-saving information and useful reference data listed in company's catalog.
A-4-10	Cadillac Stamp Co.	M-120 SE-130	Bulletins list varieties of marking methods and devices for meeting modern production demands.
A-4-181	Campbell Machine Division American Chain & Cable	DH-260	Campbell Abrasive Cutting Methods described in bulletin.
A-4-23	The Cincinnati Shaper Co.	N-5	Information given on new, magnetic time-saving clutch and brake with single control lever.
A-4-143	The Cleveland Tapping Machine Co.	TL-44	Invaluable information for engineers and operators offered in "Production Tapping Guide."
A-4-209	Danly Machine Specialties, Inc.		Free bulletin "Hydraulic Metalworking Equipment" lists advantages of using company's product.
A-4-183	Delta Power Tool Division	AB-52	Machining problems solved; low-cost, high accuracy Delta tools described in catalog.
A-4-237	Eastman Kodak Co.		Booklet "Magnifying Time" helps determine suitability of high-speed camera to your problem.
A-4-167	Engis Equipment Co.	T-453	Technical bulletin describes complete range of grades in Hypres compounds.
A-4-18A	Gisholt Machine Co.		Chuck catalog gives full information on the Gisholt Weatherhead chuck.
A-4-18B	Gisholt Machine Co.		Bulletin describing company's 5 L Saddle-type Lathe.
A-4-20A	Gisholt Machine Co.		Information booklet "Static and Dynamic Balancing" describes details of company's line of balancers.
A-4-20B	Gisholt Machine Co.		Textbook "Wear and Surface Finish" covers all phases of superfinish.
A-4-162	Hammond Machinery Builders	225	Save time, tools, wheels and step up production. See Carbide Grinder Catalog.
A-4-153	Handy & Harman		Trimetal folder tells all about new alloy for heavy-duty cutting tools.
A-4-206	Hannifin Corp.	150	32-page book relates how "Hy-Power" results in quieter operation, stronger joints, faster riveting.
A-4-142	Industrial Diamond Association of America, Inc.		"The Diamond That Pays for Itself" booklet explains industrial application.
A-4-165	The Ingersoll Milling Machine Co.	60F	Cutter catalog describes various kinds of milling cutters, boring tools, chamfering bars, fixtures and transfer equipment.
A-4-168	The B. Jahn Mfg. Co.		"The Story of B. Jahn Production Proved Dies" available for money-saving applications.
A-4-247	Jones & Lamson Machine Co.	504	Catalog "Holders for J & L Die Heads" available upon request.

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A-4-21	The Lapointe Machine Tool Co.	HP-5	Describes easy and accurate Lapointe broaching.
A-4-173	Lindberg Engineering Co.	1440	Bulletin describes method of increasing production and speeding soldering of spring assemblies.
A-4-161	Lipe-Rollway Corp.		AML Bar Feed—operation, benefits, case histories, described in folder.
A-4-228	Logansport Machine Co.		Free catalogs give extensive information on Logan Air-draulic feed-controlled cylinders, valves, fittings, units, etc.
A-4-233	Miller Motor Co.	H-104 A-105	Complete Miller cylinder line listed and described in bulletins.
A-4-263	Morey Machinery Co., Inc.		Illustrated brochure gives full details on multi-spindle drilling and tapping machines.
A-4-145-2	Morton Machine Works		72-page informative catalog contains illustrations and full-size tracing templates of products.
A-4-127	Nelco Tool Co., Inc.		New 48-page Nelco catalog describes carbide tools built to specifications.
A-4-242-3	New Hermes, Inc.	IM-41	Engravograph for heavy production in engraving—tracer-guided for unskilled labor.
A-4-29	Niagara Machine & Tool Works	89	Bulletin lists outstanding features and versatility of operations of company's tools.
A-4-179	Oakite Products, Inc.		Free booklet "Some Good Things to Know about Metal Cleaning" available.
A-4-34	Ohio Crankshaft Co.		"Typical Results of TOCCO Induction Hardening and Heat Treating" booklet available.
A-4-150-1	O'Neil-Irwin Mfg. Co.		Complete details on hand and power-operated Di-Acro benders, brakes, notchers, punch presses, given in 32-page catalog.
A-4-147-2	Ortman-Miller Machine Co.		More power packed into less space with O-M cylinders. O-M catalog gives details.
A-4-193	Rivett Lathe & Grinder, Inc.	203	Illustrations and description of all Rivett Hydraulic Valves listed in catalog.
A-4-16	Scully-Jones & Co.	17-50	Gives detailed description and technical data on "Roll-Lock" chucking tools.
A-4-14	Standard Pressed Steel Co.		"Unbrako Standards" lists advantageous features of Unbrako square head set screws.
A-4-146	Stocker & Yale, Inc.		Brand new Optical Comparator brochure outlining ten optical gaging problems and a brief basic instruction course in optical projection methods.
A-4-178-4	P. A. Sturtevant Co.		Sturtevant Torque Manual contains valuable data on design and production.
A-4-174-2	Swartz Tool Products	941	All types of holding fixtures for machine shop production.
A-4-120	Threadwell Tap & Die Co.		56-page fact-filled tap manual gives extensive information on taps.
A-4-134	Tomkins-Johnson Co.	150	Increase output and reduce costs—explained in new catalog.
A-4-240-2	U. S. Hoffman Machinery Corp.	A-690	Vacu-matic filter results in high-flow rate, self-cleaning dry sludge.
A-4-194	Van Keuren Co.	35	VK gage blocks defend production accuracy; fully described in catalog and handbook.
A-4-217	Waldes-Kohinoor, Inc.		New Waldes Truarc E-Ring Dispenser speeds assembly, cuts time and costs.
A-4-197	Warner & Swasey Co.		Free copy of "Turret Lathe Tools"—197 pages of practical information.

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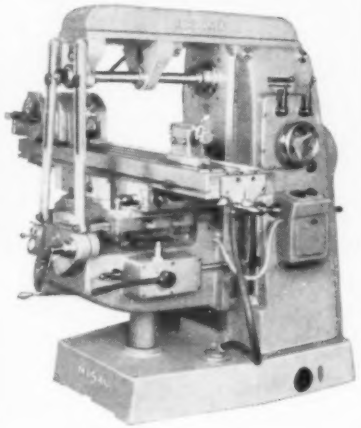

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Morse Taper NST No. 50—Working Surface 55" x 12½"—Power feed range: Longitudinal 40½"—Cross 13½"—Vertical 18½"—18 Feeds, range 3/64" to 12" per minute—Rapid traverse 80" per minute—12 spindle peeds, range rpm 25 to 1000—Motor HP 7.

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For further information write or call:

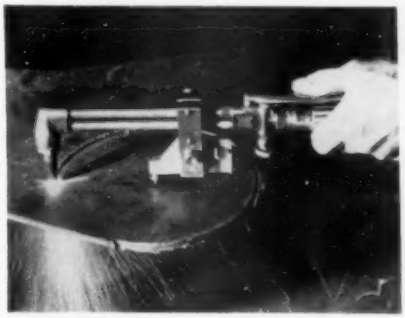
MISAL

1 E. 53rd ST., NEW YORK 22, N. Y.
ELdorado 5-7278

INDICATE A-4-139-1

Cutting Torch Guides

These guides are designed to provide simple attachments that permit accurate cutting such as circles, straight lines, bevels, and sundry shapes with no special training or skill. As emergency or standby equipment in any shop, they provide a means for quickly producing parts that would ordinarily take days if ordered from an outside source of supply. Also, they permit economy when the production of only one or a few parts is required.



Made in styles to fit all makes of torches from 70 to 90-degree models, the guides are of three principal types; a small circle guide for cutting circles from one to 15 inches in diameter, a large circle guide for circles 10 to 66 inches in diameter. A straight-line guide is available and can be arranged for straight and 60 or 45-degree bevel cutting. The guides can be attached to torches ready for use in 2 or 3 minutes; finger-tip adjustments need no tools.

The guides are offered singly or in kits to handle a variety of work. Information may be had by writing to New Era Engineering Co., Dept. G-73, 458 West 29th St., Chicago 16.

T-4-1391

Work Positioner

An electrically turned, variable speed, work positioner has been announced by All-State Welding Alloys Co., Inc., White Plains, N.Y. It is offered both as a bench model and as a pedestal model and with accessories to make it inclinable and operable intermittently.

The work positioner is easily portable. Without the pedestal the complete unit weighs 31 pounds, is 5½ inches high and covers an area 20 x 18 inches. The turntable is 15½ inches in diameter. It safely carries a work load of 300 lb and moves it continuously or intermittently at speeds adjustable upward from ¼ rpm. Electrical requirements are less than for a small light bulb. The unit feeds off any 110-v 60-cycle outlet.

The device is said to be applicable in welding, brazing, soldering, tinning, cutting and metalizing. **T-4-1392**

NOW

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This sturdy pocket size Reamer Selector is a must for buyers and users of reamers. It lists 143 hole sizes from .0400 thru .5010 which can be reamed with STANDARD L&I Reamers. Includes catalog numbers and equivalent sizes for easy ordering.

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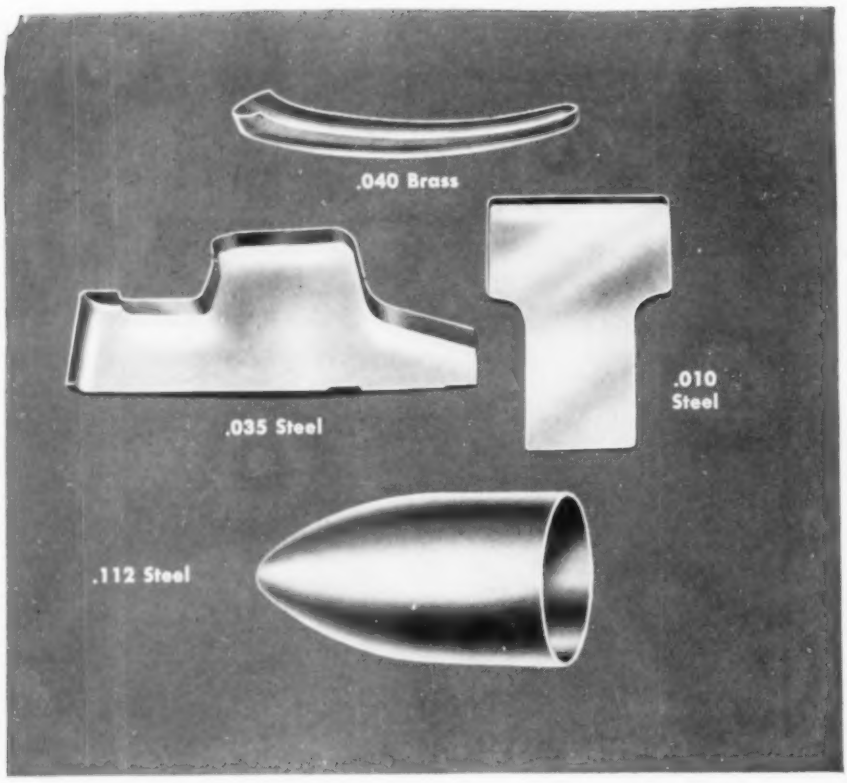
INDICATE A-4-139-2



"One Punch"
TRIMS SHELLS COMPLETE
Increase output . . . reduce costs!

Costly, time-consuming trimming and notching operations can be done in one operation with a Brehm Trimming Die. Don't worry about stock thickness. Edges will be of full thickness—clean, flat, without burrs or distortion at the trimmed edge.

Other Brehm Die advantages! **Workable Materials**—gold, silver, stainless or mild steel, copper, brass, zinc, aluminum, fiber, rubber, plastics, or what did you have in mind? **Quantities vary**—stove or refrigerator doors, auto bumper buffers or typewriter covers, from 264 to 900 per hour. Intermediate parts, where stock and scrap can be blown from the die, about 1200 per hour. **Shapes**—fountain-pen ferrules, artillery cases, watch cases, burial vaults, automotive, kitchen, radio and television accessories and parts. Almost anything *you* need trimmed.

A Brehm "Shimmy" Trimming Die with angular cams, cuts four ways in one press stroke, handling straight or curved edge contours, with multiple notches and projections. Slow, costly "horn" and "pinch" trimming operations are eliminated.

Write today . . . for your free copy of the Brehm Die Catalog. If you wish, submit blueprints or parts for full information or quotation.

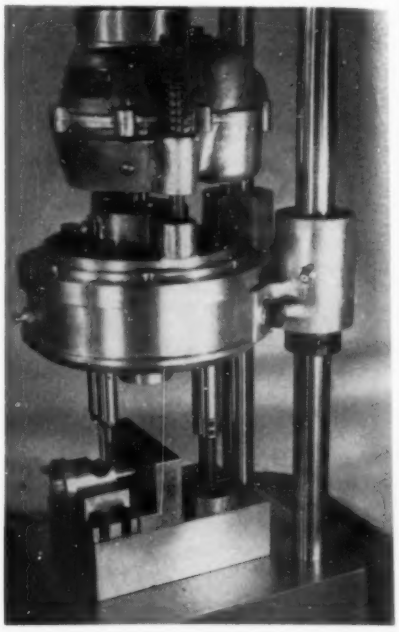
THE "SHIMMY" REG. DIE **Brehm®** TRIMMING DIES

THE STEEL PRODUCTS ENGINEERING CO.
BREHM DIE DIV., DEPT. 8 SPRINGFIELD, OHIO

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-140

Multiple Tapping Head

The multiple tapping of two or mo small holes can be done with lead scre protection on any drill press with Ett Emrick self-contained leadscrew mult ple tapping units. This is possible ev



though the tap sizes, pitches, or both, are not the same. The unit consisting of a reversing head, a three-spindle multiple head and a fixture, taps two 0-80 holes in aluminum. The lead-screw, having a fast pitch, runs slower than the taps and is completely enclosed during operation, thus assuring precision tapping with long life.

For further information, write to Ettco Tool Co., Inc., 594 Johnson Ave., Brooklyn 37. **T-4-1401**

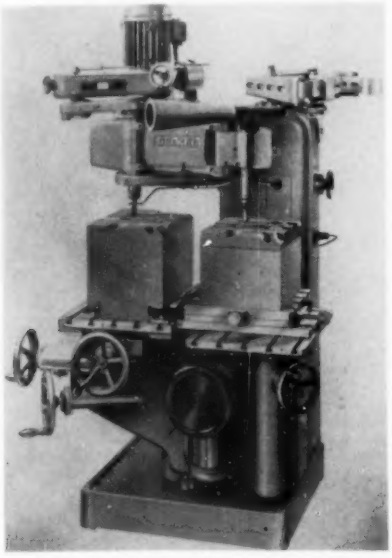
Pipe Line Filter

Four small pipe line filter models designed for installations requiring only 40 psi maximum pressures for compressed air or gas, have been announced by the Dollinger Corp., 11 Centre Park, Rochester 3. The filters feature one-bolt accessibility for quick inspection and cleaning without removing filters from the line.

The small pipe line filters are available in any one or a combination of four models. They are manufactured in two sizes and each size can use either absorption pad media or the original Dollinger radial fin inserts. Larger size filter has a diameter of 3½ inches and a length of 6½ inches. Larger size is 3½ inches in diameter with a length of 10 inches and offers more filtration surface. The AA series of filters with absorption pad media remove last traces of oil and water vapor from lines. The CH series with radial fin inserts are designed to rid lines of dirt and pipe scale. **T-4-1402**

Die Sinking Machine

The Deckel model KF12 universal pantograph die sinking machine, introduced by Cosa Corp., 405 Lexington Avenue, New York, performs a wide range of copy milling operations from die sinking of large and intricately shaped dies and molds to light engraving. Dies and molds are accurately reproduced with high surface finish at economical production rates. The pantograph system permits two-or three-dimensional milling at 1:1 ratio and reductions or enlargements from 1:1.5 to 1:4.

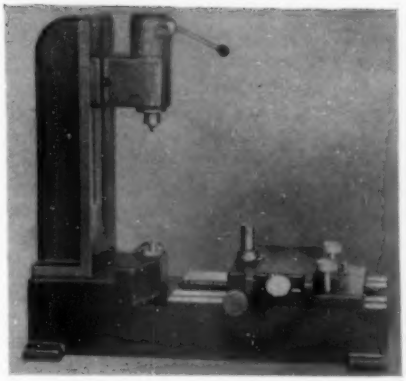


Improvements have been made to these larger die sinking machines. The cutting area and working capacity has been increased. In a single setup, the cutting tool will cover an area of 15¾ x 15¾ inches or 10 x 19¾ inches. These cutting areas can be utilized to their fullest extent even with die blocks up to 15¾ inches in height.

The power-operated vertical saddle permits both the master and workpiece to be raised or lowered simultaneously at a rate of 30 inches per minute. The rough milling spindle has a built-in speed reducer and will hold collets for chucking tools with No. 2 Morse taper or straight shanks up to ¾ inch in diameter. The 1.5-hp spindle motor assures positive nonslip spindle operation even under low speeds and heavy cuts. Infinitely variable spindle speeds range from 60 to 10,000 rpm, permitting the selection of the most economical cutting speed for any material. **T-4-1411**

Rolling Fixture

A model 602-A bench-type rolling fixture that checks size, eccentricity and roll smoothness of cluster gears and similar types having integral shafts and centers is announced by Michigan Tool Co., 7171 E. McNichols Road, Detroit 12.



The fixture features a heavy cast iron base, scraped ways and hardened and ground ball ways. It has a spring-return, lever-controlled retractable upper center. Center distance is adjustable from 2 to 10 inches. Maximum distance between centers on the overarm is 12 inches.

Gears to be checked are loaded between centers on the overarm. The master gear is brought into mesh with the gear by an eccentric lever control. Correct tension between the gears is maintained by spring-loaded ball ways. Turning the gear manually causes a 0.0005-inch indicator to show variations in size, eccentricity and roll smoothness.

The model 602-A rolling fixture is 9½ inches wide, 29 inches long and 26¼ inches high. It can be used in conjunction with the Michigan model MTR-50 automatic recorder to place all readings on permanent charts. **T-4-1412**

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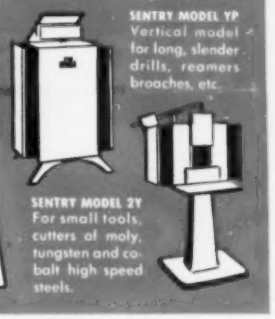
SENTRY

The Better Way To Heat Treat High Speed Steel!



SENTRY MODEL YP
Vertical model for long, slender drills, reamers broaches, etc.

SENTRY MODEL 2Y
For small tools, cutters of moly, tungsten and cobalt high speed steels.

IF IT'S P-K IT'S O.K.

Sentry Busy at PARKER-KALON for Over 15 Years!

Harold Rosenberg, Works Manager at Parker-Kalon in New York, says: "We have been using our Sentry Furnaces on a multiple-shift basis for more than 15 years. Throughout that period we have relied on Sentry for all of our high speed, high carbon and high chrome tool steels. It's gratifying to know that we can depend on Sentry to help us maintain our famous P-K quality."

Request Catalog P-4

Sentry 4Y installation at Parker-Kalon Corporation, New York, N.Y.

THE SENTRY COMPANY

FOXBORO, MASSACHUSETTS

INDUSTRIAL ELECTRIC FURNACES AND EQUIPMENT FOR HEAT TREATMENT OF METALS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-141

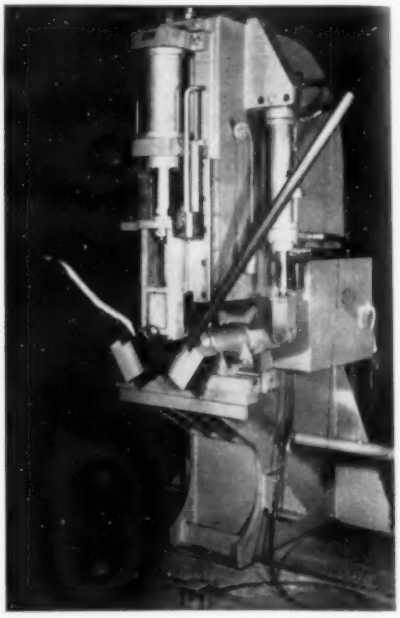
Bending Press

A vertical ram-type and pipe bending press, designed with unusual working clearance to speed handling a variety of multiple bends in different planes, is announced by Pines Engineering Co., Inc., Aurora, Ill. The press is a fully-hydraulic, self-contained unit with a rated capacity of 20 tons. Design features include twin equalizing cushion cylinders offset on the press frame, automatic angle-of-bend cycling with automatic return to starting position, variable speeds, oil coolers, single screw adjustment for wing dies, movable foot control and shortened die holders for maximum clearance.

The unit has adequate power and capacity for repeat bending of ½ through 2-inch OD steel tubing with a maximum wall thickness of 0.083 inch without excessive flattening, wrinkling, or distortion. Clearance is provided to bend a 2-inch tube with a 5-inch centerline radius to 180 degrees.

The base and upright members of the press consist of a hot-rolled welded steel framework incorporating oil reservoir, pump, motor and valve-mounting units. The pump and motor are located outside of the oil reservoir, providing easy accessibility for inspection and maintenance. The framework is stress-relieved after welding to prevent distortion.

The vertically-mounted ram is operated by a 12-inch stroke, double-acting hydraulic cylinder, which is direct-connected to the guide ram slide. The cylinder is located above operator level, which does not impair operator efficiency during hot weather operations. The ram slide is retained by Ampco bronze wear strips and gibs.



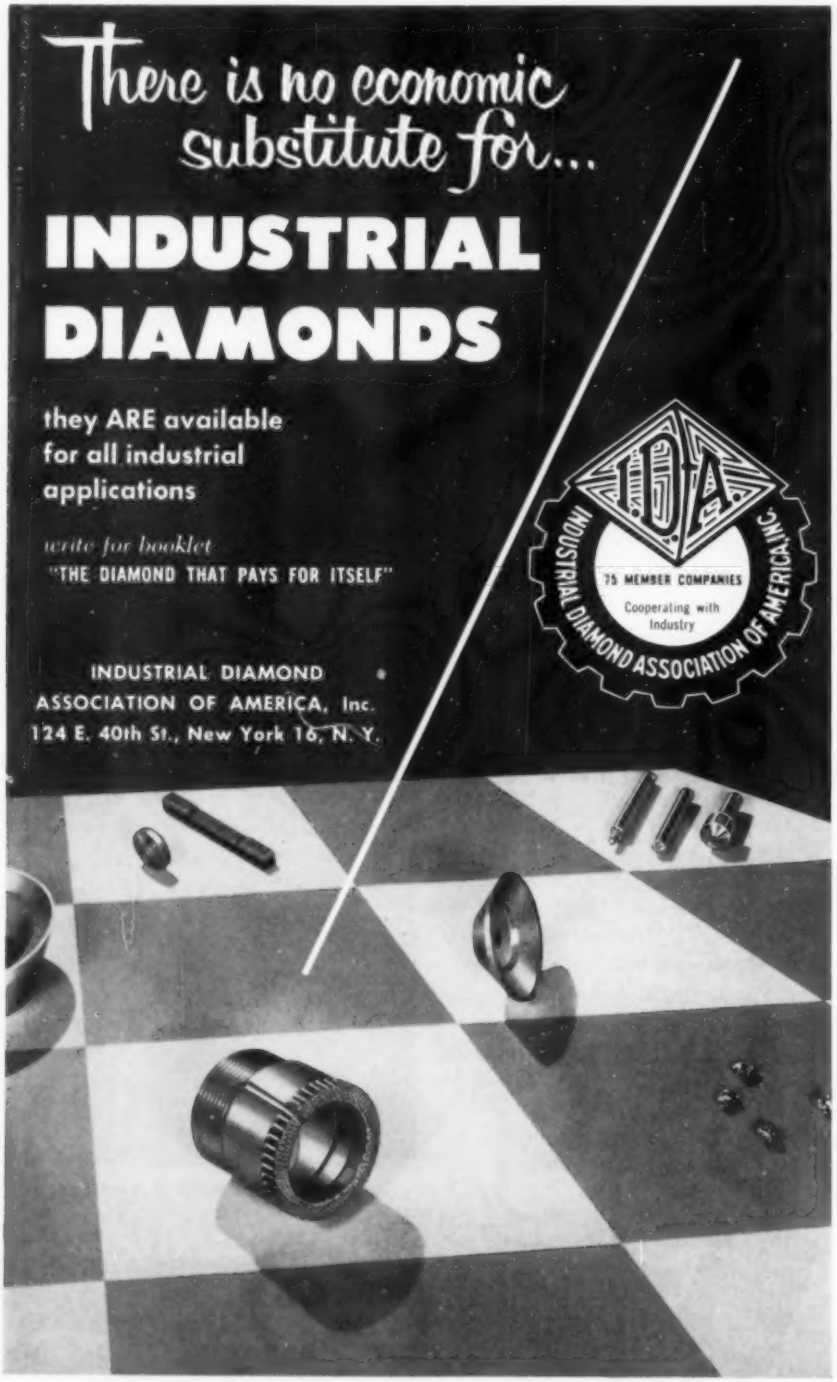
Ram speed under no load and on return stroke is double the working speed.

The press bender is also equipped with twin built-in oil cooler units which maintain uniform oil viscosity.

A movable, foot-controlled switch permits positioning to reduce operator fatigue. Momentary contact of the switch starts the cycle. A separate safety stop is conveniently located adjacent to the ram slide.

Power is provided by a 2000-psi Vickers pump. Alemite grease fittings are located on the ram slide ways, the wing holder spindles, and crankpins. The press is supplied with all necessary motors, motor starters, and controls for operation on 220-440 volt, 3-phase, 60-cycle current. Control circuits operate on 110 volts, 60-cycle, with step-down from line voltage through a transformer. **T-4-1421**

USE READER SERVICE CARD ON PAGE 137 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-142

Non-Slip Handwheel

A non-slip handwheel has been patented and is being introduced by The Lunkenheimer Co., Cincinnati 14, Ohio.

Designed to turn easily and safely, the non-slip handwheel represents a departure from the conventional type of valve wheel it replaces.

The maker will standardize on this handwheel for its complete line of bronze and iron valves, which formerly were equipped with regular malleable iron wheels. Like its predecessor, the non-slip handwheel also is made of malleable iron, but there the resemblance ends.

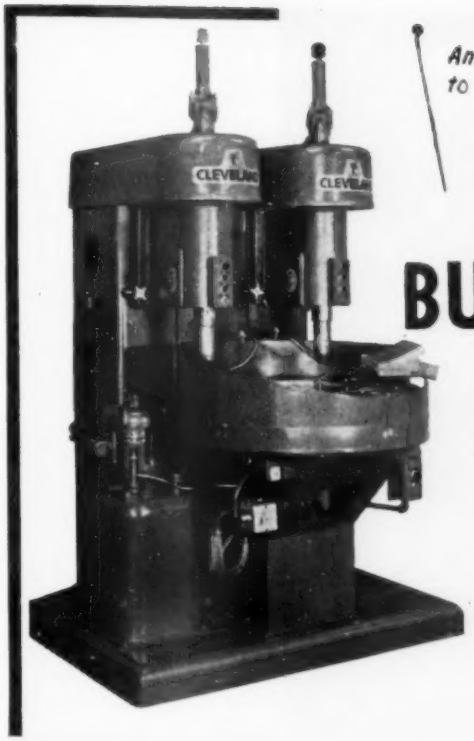
The new handwheel features four finger-spaced lugs, all continuations of the strong spoke structure, projecting from the stem hub through an exceptionally rugged octagonal frame. This design permits the operator to get a firm, comfortable grip on the handwheel and apply a high pressure, even though his hand may be wet or greasy. The shape of the handwheel is such that it eliminates the possibility of burned hands from contact with the valve stem.

By virtue of its sure, easy grip, the non-slip handwheel assures complete, tight closing, thus eliminating leakage, a common cause of valve erosion, wire drawing and failure. **T-4-1431**

Helix Milling Cutter

A high helix, shear type milling cutter has been announced by the Douglas Tool Co., 2300 E. Nine Mile Rd., Hazel Park, Mich. It has a cutting surface of more than 90 degrees and is designed to mill compound contoured surfaces.

The teeth are always in contact with the workpiece, clean themselves and impart a very smooth finish. Douglas milling cutters are well suited for cutting turbine compressor blades, stator vanes, buckets and generating cams. A special adapter makes possible their use on any milling machine. **T-4-1432**



Another Cleveland Design to Speed Production!

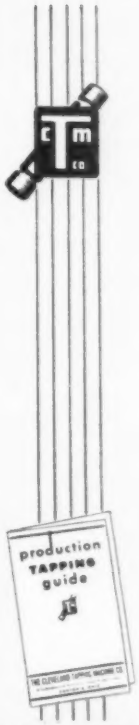
MORE BUSHINGS— FASTER!

MODEL E4U DUPLEX FOR 1¼" to 2½"

To get maximum speed on larger bushings Cleveland designed this Duplex machine with a 6 station hydraulic table. It will drill and tap 1¼" to 2½" bushings with a production of 730 pieces per hour of the 2½" size at 100% efficiency. Production of smaller sizes is of course considerably higher.

Like all Cleveland Tapping Machines it utilizes the now famous precision lead screw feed that assures you of more perfect pieces at top speeds. The result is lower costs.

Keep in mind that over the years Cleveland engineers have been designing special tapping machines to meet a varied range of requirements, often combining several operations in one machine. This accumulated know-how can be put to work for you. A machine designed by Cleveland engineers to meet your special requirements will definitely result in lower production costs.



This Tapping Guide has invaluable information for engineers and operators. Send for your copy.

Write today for Catalog No. **TL-44**

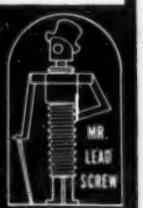
THE CLEVELAND TAPPING MACHINE CO.

A Subsidiary of
AUTOMATIC STEEL PRODUCTS, INC.

CANTON 6, OHIO

For Better Tapping--Faster!

CLEVELAND lead **tapping machines** screw



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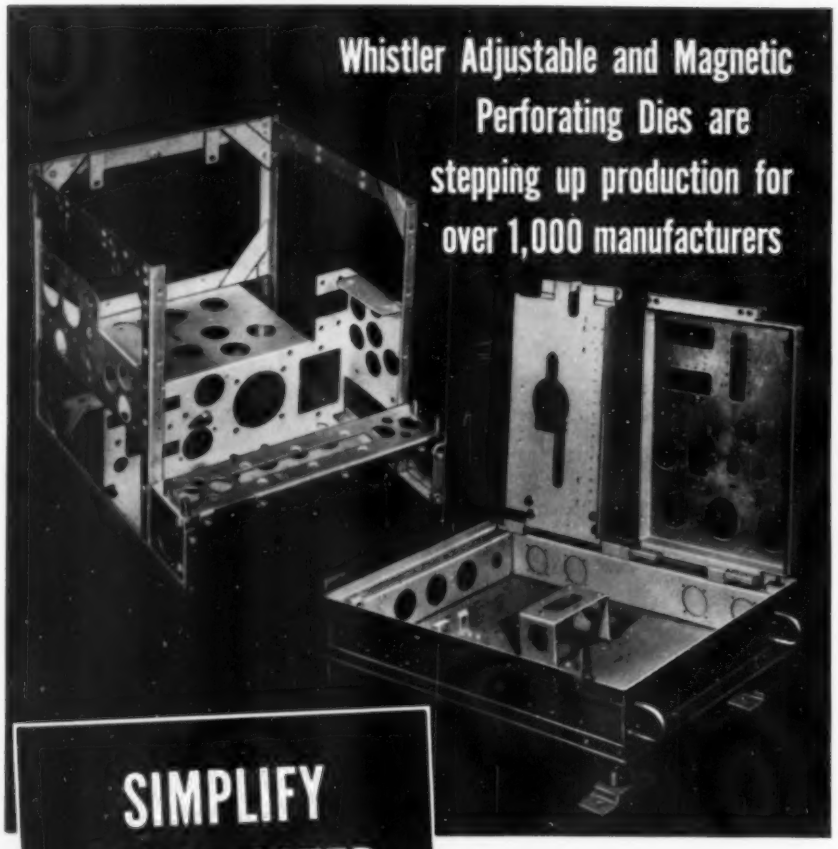
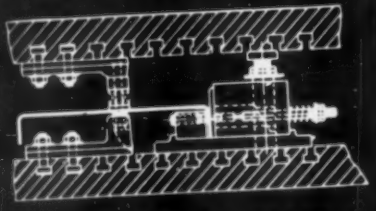


SIMPLIFY COMPLICATED PIERCING OPERATIONS



Use this HU-50 90° Perforating Unit on the same job with other Whistler Dies ...often saves extra press operations.

USE WHISTLER Adjustable and Magnetic Dies for perforating, notching and slotting sheet metals ... fast, accurate and cost cutting. Complicated patterns can be set up quickly. Hole arrangements can be changed in the press...without waiting and at no extra cost. New HU-50 units, that pierce at 90° angle, can be used in conjunction with standard perforating equipment. Fewer press operations are necessary.

Re-use the same dies in different arrangements on many jobs. Punches and dies are interchangeable.

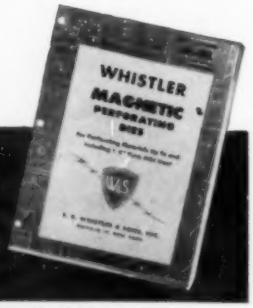
Whistler Adjustable Dies can be used in practically every type press. Standard sizes and shapes of punches and dies available up to 3 inches. Special sizes and shapes to order.

S. B. WHISTLER & SONS, Inc.

744 Military Road

Buffalo 23, New York

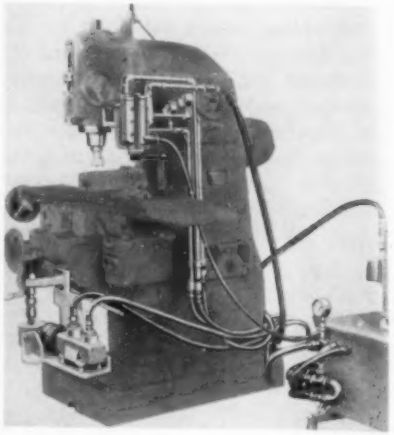
For prices and application data on this modern way to speed production and cut unit costs, write for these illustrated Whistler catalogs.



FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-144

Copying Machine

A Bondycop hydraulic copying machine for use on milling machines has been introduced by Morey Machinery Co., Inc., 410 Broome St., New York 13.



This Bondycop attachment for milling machines permits the machining of complicated shapes such as turbine blades, molded parts, plastic shapes, etc. It assures the uniform quality of the machined parts, avoids defective pieces, insures great accuracy and is capable of both large and small runs.

The attachment, which is easily installed on any normal milling machine, can be operated by unskilled labor, and is obtainable in several sizes. It is protected by patents. **T-4-1441**

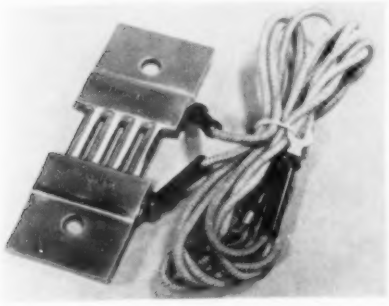
Roughness Specimens

A line of roughness comparison specimens, also known as Surface Sticks, has been announced. According to the manufacturer, these specimens were designed to meet the need for a low cost, yet practical, accurate means of determining smoothness or roughness of a surface.

Simple, easy to use, they consist of various surface specimens individually finished to definite microinch readings and grouped together in finish-comparison bars. The operator holds the specimen bar opposite his work to make a fast, accurate visual comparison check of surface roughness, waviness and lay. Surface finishes can be instantly compared and checked for conformation to specifications at the machine. Acme roughness comparison specimens can be furnished in approximately 1x1 inch round plug form, and in approximately 1x1½x1 inch rectangular blocks, in boxes accommodating 3, 5 or 8 assorted surface finishes. For details, write to Acme Industrial Co., 200 N. Laflin St., Chicago 7. **T-4-1442**

DC Ammeter Shunts

Rapid Electric Co., 2881 Middletown Road, Bronx 61, has announced a complete line of direct current ammeter shunts designed for use with 50-millivolt meter instruments. Sizes range from 150 to 10,000 amperes. These units are calibrated to with ½ to 1 percent accuracy and are complete with 10-ft.



calibrated leads. Each shunt is designed to maintain its accuracy at 100 per cent overload, thereby making it applicable for use at twice the rated capacity with 100-millivolt instruments. All units are constructed with solid copper ends and solid manganum rods between copper. Due to the extra heavy duty construction and the extremely low temperature coefficient of the metal alloy, perfect accuracy is maintained when used at maximum capacity and at ambient temperature up to 350 F. Force fitting of over ½ inch of manganum rod into both metals has produced an instrument that is not only impervious to extreme shock but will resist a parting force of many times its ampere rating in pounds.

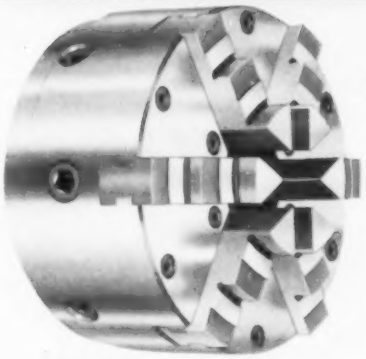
T-4-1451

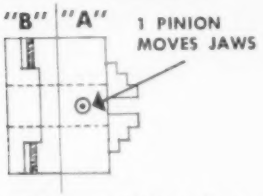
Air Impact Press

To meet the needs for production equipment, Cadillac Stamp Co., 17315 Ryan Road, Detroit 12, has completed development of the Cadillac 52 air impact press. Its speed offers up to 10,000 strokes per hour and pressure is obtainable up to 8 tons from a 100-lb airline. It is adjustable from light to heavy marking. It can also be regulated to give proper ram action required for branding or color leaf marking. It is also adaptable for assembling, staking, crimping, riveting, and for producing light stampings. The press can be actuated by hand, foot or electrical controls. For average work, no special jigs or fixtures are required, and the machine has automatic controls which make possible high production. The press marks uniformly even where variations exist in material thickness, holding impression depths to any desired tolerance.

T-4-1452

The UNIVERSAL Chuck with .0005 PRECISION!





HOW and WHY it Works

Chuck gripping section "A" is like any scroll chuck with one pinion to make jaws. (accurate to .003"). Section "B" shows how chuck "floats" on adapter (.020" clearance) where 4 opposed screws move chuck on adapter for adjustment to dead true precision. Jaws always come back within .0005" on duplicate work.

Buck AJUST-TRU CHUCKS

6 JAW 6" CHUCK HANDLES WORK OF 93 COLLETS!

The capacity of $1,000 worth of collets for your tool room PLUS scroll chuck rechucking speed on duplicate parts with .0005" precision . . .

The firm grip of 6 jaws for soft metal or tube work . . .

An end to most needs for stub arbors, mandrels, or special fixtures . . .

A reliable precision chuck adaptable to lathes, screw machines, grinders, dividing heads . . .

The greatest development of recent years to save machinists' time . . .

That's the brief story of this sensational Ajust-Tru chuck. It is unbelievable — but true! Send for catalog with full details.

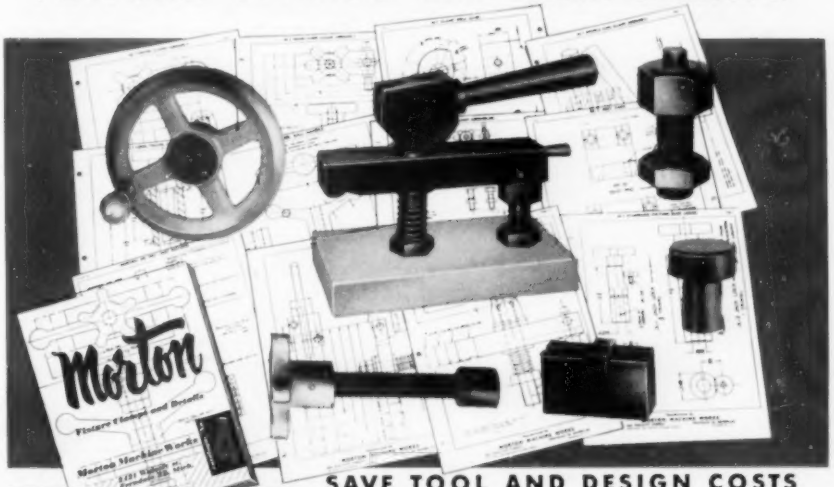
SIZES AVAILABLE

3- and 6-Jaw Chuck—4" (light duty); 5", 6", 7½" (heavy duty)
2-Jaw Aviation Chuck—6", 7½" (heavy duty)

BUCK TOOL CO.
333 Schippers Lane • Kalamazoo, Mich.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-145-1

Specify Morton FIXTURE CLAMPS and COMPONENTS



SAVE TOOL AND DESIGN COSTS

Adopt Morton's Fixture Clamps and Components as STANDARDS. Largest range of sizes and types in the Industry. Can be modified to whatever changes you specify.

UPON REQUEST
72 page informative Catalog including illustrations and full size tracing templates of each product.

MORTON MACHINE WORKS
2421 WOLCOTT ST. DETROIT 20, MICH.

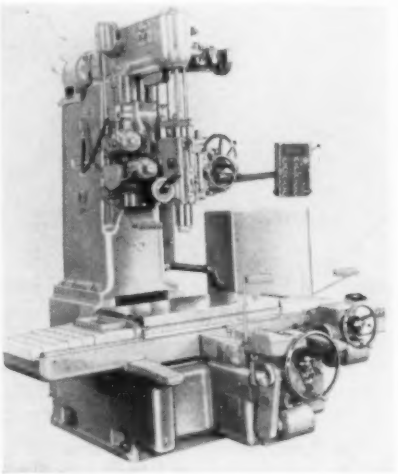
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-145-2

Jig Borer

The No. 2E jig borer has been added to the Electrolimit series of jig borers manufactured by Pratt & Whitney, Div. Niles-Bement-Pond Co., West Hartford 1, Conn. Featuring the Electrolimit measuring system and the preloaded ball roll quill, the 2E is capable of locating and machining to tenth.

The jig borer employs two separate Electrolimit measuring units, one for longitudinal and the other for transverse movements. Both measuring units are independent of traversing screws. Each unit obtains basic one-inch spacings electromagnetically from a solid notched master bar and registers a zero reading on an indicating meter without making physical contact. Fractional inches are obtained by moving a small electromagnetic head by means of a super-precision micrometer head graduated for easy reading to 0.0001 inch. Since a $\frac{1}{32}$-inch movement of the 4½-inch diameter micrometer thimble represents a setting change of 0.001-inch, smaller estimated settings are possible.

The precision preloaded ball roll quill, unlike conventional sleeve bearings, roll-feeds, on 288 precision ball preloaded between the hardened quill and liner with a total bearing pressure of 6,000 lb. The head bore is provided with a hardened and ground steel liner deep-frozen for assembly and precision lapped in place. The quill is hardened, precision-ground and draw-lapped for extreme accuracy and to lay the surface pattern in the direction of motion, which is essential to maintain permanent accuracy. The great stability of the ball roll quill makes milling feeds



practical for the table and carriage. Operation of the head assembly vertically is controlled by push buttons. An automatic inter-locking mechanism clamps the head positively in position on the column after motion and releases it before motion starts.

The jig borer has electronically controlled milling feeds infinitely variable from 1 to 15 inches per minute. Rapid power travel of 60 inches per minute is also provided. There are eight selective spindle feeds ranging from 0.0005 to 0.015 inch per revolution, both up and down. Twelve spindle speeds ranging from 37 to 1800 rpm are provided through a gear box and four speed motor.

Ample working space is provided with a 22 by 44 inch table; travel is 36 inches longitudinally and 22 inches transversely. Maximum height between table and spindle end is 27 inches. Special columns 6 or 10 inches higher than standard can be furnished, increasing the machine height accordingly.

T-4-1461

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RIGID ARM for extra stability on bench or machine —Model 16-9-913E, also available with side mount.
CONVERTING old fixtures into modern lighting. The famous Lite-Mite screw-in bulb—Model 16-2E.
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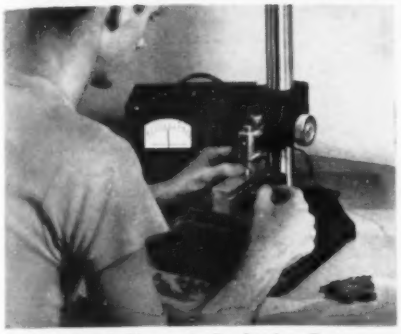
FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-146

USE READER SERVICE CARD ON PAGE 137 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Here's instantaneous dimensional gaging

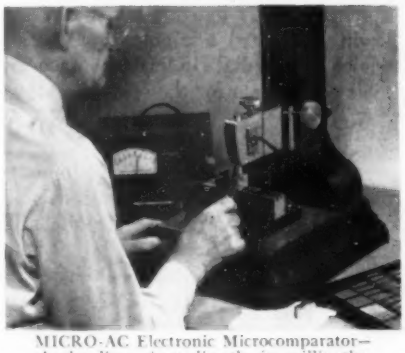


PAR-AC Electronic Production Gage, for high-speed repetitive gaging.

in tenths of "tenths"

INDI-AC Electronic Indicator — for all-around checking and surface-plate work.

on high-production or toolroom work



MICRO-AC Electronic Microcomparator—checks dimensions directly in millionths.

. . with RECORDING of measurements when desired

Cleveland Electronic Gages provide the dependable, numerical data required for statistical quality control. Features include consistent repeat readings; instantaneous meter response; dual sensitivity; fast, easy setup. Gage heads and amplifiers are readily adapted to special applications, including automatic gaging.

Write for descriptive bulletins.

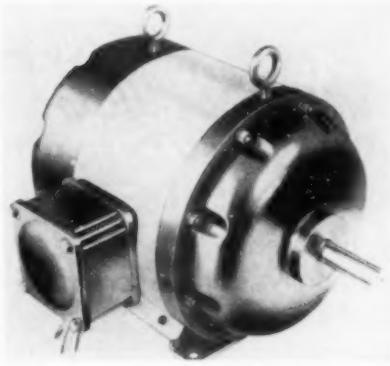
CLEVELAND INSTRUMENT COMPANY
741 Carnegie Ave., Cleveland 15, Ohio

INDICATE A-4-147-1

Explosion-Proof Motors

The Industrial Motor Div., Robbins & Myers, Inc., Springfield 99, Ohio, announces production of a line of motors in ratings from one to 40 hp, in NEMA frame sites up to 405. The motors will be available in totally-enclosed and Underwriters' Approved explosion-proof construction.

Special class A chemical insulation treatments permit the use of the new motors in applications involving acids, alkalis, dying and bleaching, canning and packing, and peroxide.



A wide variety of construction modifications is available, including a choice of cast bronze, cast aluminum, or cast iron ventilating fans. Cast bronze, cast iron, stainless steel, or flattened expanded metal ventilating grilles may also be specified. Automatic drain and breather plugs, as well as stainless steel shafts, can be supplied if desired at slight extra cost. All frames are constructed with stainless steel outer shells.

In addition to the special treatment these motors receive to make them suitable for chemical applications, added attention is given to protect metal parts against corrosion. Steel parts are dipped in a special corrosion-resisting coating. Steel parts are then baked and painted. The die-cast rotor is sprayed with a special corrosion inhibitor. The cast iron end heads and terminal box are cleaned and treated with a combination zinc chromate and iron oxide primer.

The terminal box on totally-enclosed models is gasketed and power leads are sealed at the shells with a nonhardening compound. Repellent grease at the shaft extension hub keeps moisture away from the bearings. These bearings, prelubricated and sealed on both sides, are double-row width.

T-4-1471

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In close quarters, an O-M Cylinder really shines because it is ALL CYLINDER! The *interlocking mechanism*, which does away with tie rods and projecting end caps, means that *more power is packed into less space.* Saves up to ½ installation space. Also provides perfect alignment, friction-free performance. Easier to install and repack. End plugs tapped for universal mounting . . . with a complete range of mounting brackets, interchangeable bore for bore. All machined steel, with bearing bronze (no castings)—easily turned down to fit in deep recesses of machines or bases. Available in full range of sizes (1½" to 8" bores) with standard, 2 to 1 or oversize rods. *Completely interchangeable parts.*

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☐ Please send latest O-M catalog.
☐ Please send complete set of templates.

Name.....
Company.....
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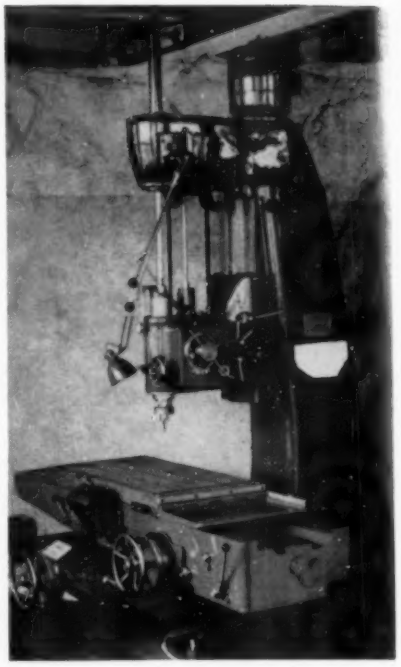
INDICATE A-4-147-2

Jig Borer

The OMI jig borer is of column type and works according to the coordinate-system. The table, being located on a cross support, is adjustable in x as well as y-shaft. The spindle location is fixed. The setting of the table is done by screws and the measuring position to be obtained by fine dials which are read off by microscope. The graduation of the microscope is adjustable by a micrometer screw with graduated dial divided in 0.0001 inch. The setting of the table is carefully made and is maintained during the whole running of the machine. Faulty pitch on the screws does not affect the right setting of the table. The table can be manually traversed in both directions by means of handwheels as well as power traversed.

Since the machine is also suitable for cutting, the table is fitted with self-feed in both the direction of x as well as y-shaft. The spindle is made of hardened nickel chrome steel and provided with SKF roller bearings. The spindle sleeve, also hardened and ground, is carefully located in an exchangeable bushing in the spindle head. The spindle and the spindle head are each balanced by means of counterweights inside the support. The spindle drive is from the vertical motor by a gear case with gears made of case-hardened nickel chrome steel with scraped teeth.



Distributed by O'Dowd Machinery Co., Inc., 135 Front St., New York 5, the machine is delivered with the following standard equipment; centering device with dial indicator; arboring tools and collets for the spindle.

The machine can be delivered with an ordinary dividing table of 424 mm diameter and fitted with dividing plates for all divisions up to 100 mm as well as an adjustable dividing table with table diameter of 424 mm. This table, however, is adjustable in all positions from horizontal to vertical, i.e. 90 degrees and with reading of 1 mm. The division is read off on a graduated dial with accuracy of min. 5 seconds.

The OMI coordinate borer may be used with great advantage not only for production of jigs, boring and cutting, but also for direct production. Many kinds of work can be effected in this machine, more speedily and with greater precision than in other makes.

The OMI borer is convenient to work with. With the column type everything is easily reached and the working piece is easily placed on the table. All wheels and other operating parts are within a person's reach from one place. The construction of the machine is for most various kinds of works.

The OMI jig borer is particularly amply dimensioned and made of the finest material throughout. The rigid construction and careful design insures absolute accuracy of the job and low tool maintenance costs. **T-4-1481**

Severance Regrinding Service

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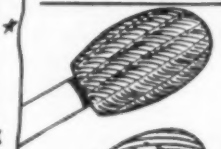

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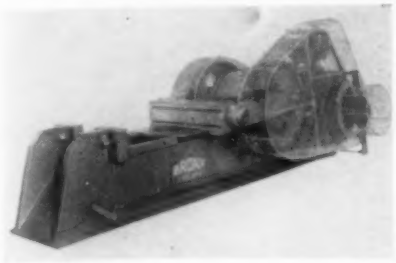
If you don't have a SEVERANCE "ALL STAR" Catalog ask for one today! It also lists Countersinks, Ball Seat Reamers and other tools of "CHATTERLESS" Tooth arrangement with the latest improvements by the originator of this type tool.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-148

Forming Machine

A 100-ton forming and bending machine manufactured by Bronx Engineering of Stourbridge, England is being offered by British Industries Corp., 164 Duane Street, New York 13.

The series B100 Bulldozer is designed for forming and bending of warm stock. However, because of the rigid bed, cold forming can be done up to the capacity of the machine.



A feature of the machine is that different tools may be set up on top of one another so that successive operations may be done in the same heat. Also, upsetting, punching and shearing are possible with a few small changes.

The machine is driven by an adjustable friction clutch drive, which is designed to slip before any damage occurs to the machine in the event of an overload. The brake and clutch are interconnected so that the operator can inch the machine with complete control.

Specifications are: stroke, 10 inches; strokes per min., 15; face of crosshead, 36 x 10 inches; hp, 10; daylight with crosshead forward, 10 inches.

Because of the special design features, the Bulldozer can be operated at high rates of speed, thus utilizing the heat to best advantage. **T-4-1491**

Coolant Pump

A medium-duty portable coolant pump has been announced.

The self-contained pump, model 8-5 has a $\frac{1}{15}$-hp motor of single bearing open type with splash shield.

The pump is of centrifugal design with full-floating balanced impeller. There are no bearings in the pump. It is a cast aluminum housing. The liquid coolant is drawn into one pump from top and bottom, neutralizing all thrust. The pump is self-relieving under excessive pressure, thus preventing strain on the hose when the pet cock is shut off.

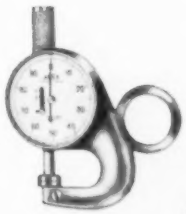
The heavy-gage steel tank has a 5-gallon capacity and is equipped with chip screen and heavy bail handle. The unit is 21 inches high and 11 inches in diameter. Further information may be obtained from the Shellback Mfg. Co., 11831 Hamilton, Detroit 3. **T-4-1492**

AMES

No. 2
Dial Comparator

This is smallest in the Ames' line of high quality dial comparators and it is ideal for desk or bench use in the fine inspection of small precision parts. It is light in weight, but its broad base makes it very stable. The capacity approximates that of the regularly supplied Ames No. 202 Dial Indicator which has a dial numbered 0-100, graduated in .001" and with a .250" range. Should your job requirements differ, you can have the No. 2 with any Ames "Hundred Series" Dial Indicator. Send for Ames Catalog No. 58 covering the entire line of Ames Top Quality measuring instruments or, better still, send complete details of your Quality Control problem. Ames will suggest a solution – no obligation, of course.

Ames Long Range Dial Indicator No. 2822



Ames Dial Micrometer No. 516

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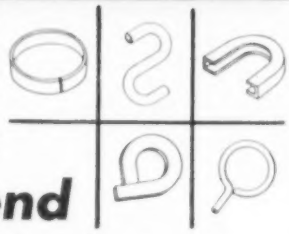

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O'NEIL-IRWIN MFG. CO.
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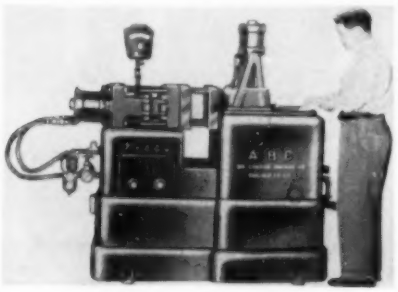
di-acro PRECISION METALWORKING MACHINES

INDICATE A-4-150-1

Die Casting Machine

A 1½-lb. zinc die casting machine, designed for smaller castings and short runs, has been introduced by the ABC Die Casting Machine Co., 339 West 112th Place, Chicago 28. According to the manufacturer, this machine was specifically designed for those companies whose needs do not require a large machine, yet who have need for fast cycling equipment to produce small sound castings and for short run production.

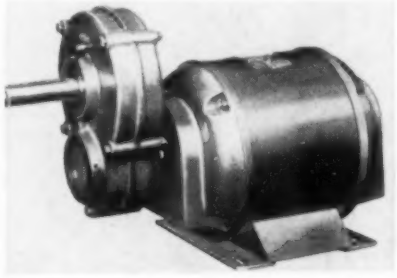


The machine is air-operated and is capable of a free cycling speed in excess of 1000 shots per hour. In addition to easy setup and operation, the machine's lightning production speed makes inexpensive single cavity molds practical and profitable. Its rugged construction is designed for trouble-free efficient operation. Additional features of this machine, designated Model 1500, include an electronically controlled panel; 10x10x2½-inch die blocks; four tie bars; and semiautomatic cycling with adjustable timing dwell on opening and closing of the toggle.

T-4-1501

Speed Reducer

This unit, the model 3R3 Uni-reducer, enables the conversion of electric motors into geared motor type reducers at a small cost. The reducer slips onto the motor shaft, eliminating the usual coupling from the motor shaft to the reducer. It is designed to fit standard



motors from 1 to 5 hp, 1800 rpm, 1 to 3 hp, 1200 rpm, 900 rpm, motors can be fitted with the Uni-reducer and it can be furnished as a complete unit with a high torque motor. With a reduction ratio of 3.04 to 1.

For further information, write the Turner Uni-Drive Co., 3400 Terrace St., Kansas City, Missouri. **T-4-1502**

Zagar gearless drillhead, 12", 24-spindle; capacity up to 5/8" steel.

Zagar GEARLESS DRILLHEADS *excel* for drilling on close centers

Their unique features have earned for Zagar gearless drillheads a permanent place in many industries. Examples: gas burners, acoustical tile, parts for aircraft (jet engines), business machines, electrical appliances, automotive and farm machinery; drilling cast iron, stainless steel, paper, fiber glass, magnesium, aluminum, brass and copper.

Why this versatility? Because Zagar gearless drillheads (1) can drill practically any number of holes at one pass, up to 600 or more; (2) can drill any material; (3) can drill in any pattern; (4) can "come down to" distances between holes as small as twice the drill diameter; (5) can and do maintain accurate spacing. High production thus combines with complete accuracy to deliver more work and more acceptable work in less time than ever before. Zagar gearless drillheads can be furnished as complete units or can be adapted to any standard drill press. Your parts drawings and full data will bring you a prompt quotation.

Write for Engineering Manual "E-4" for more information on Zagar's tools for industry.

ZAGAR TOOL, INC.
24000 LAKELAND BLVD.
CLEVELAND 23, OHIO

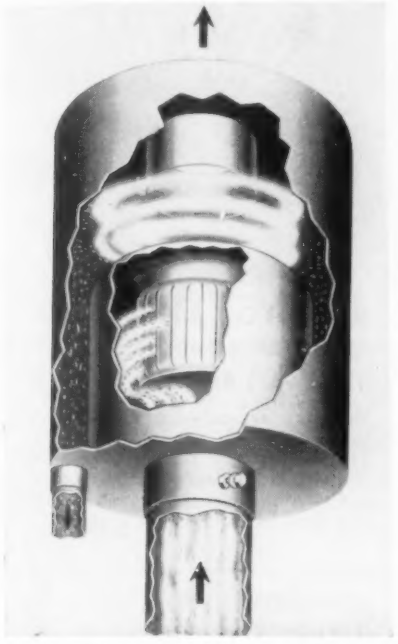
Zagar TOOLS For INDUSTRY and SPECIAL MACHINERY

INDICATE A-4-150-2

Exhaust Head

An exhaust head has been developed for industrial stacks to clean up exhaust steam and vapors discharged to the atmosphere. This unit effectively cleans up the vapor so that no nuisance particles such as troublesome oil and process liquors are vented which attack machinery, nearby buildings and/or create a public nuisance.

This exhaust head has no moving parts or filters. The entrainment laden vapor entering the purifier is engaged by a stationary centrifugal element which imparts a carefully controlled but extremely rapid rotational motion to the

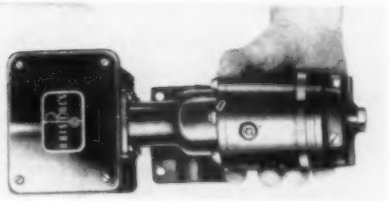


vapor. This action guides all dirt particles, guck, oil and water outward to the walls of the purifier. Here it is drained to and ejected out the drain. The clean, dry steam continues upward and is discharged to the atmosphere. The unit is guaranteed 99 percent effective and the manufacturer states the greater the velocity through the unit the greater the operating efficiency.

Although fabricated to specification, standard models have a slip-on or flange connection for the stack and a threaded connection for the drain; fabricated steel body and stainless centrifugal element. For further information write to Dept. EH, The V. D. Anderson Co., 1935 W. 96th St., Cleveland 2. **T-4-1511**

Pneumatic Transmitter

A miniature pneumatic transmitter for measuring and transmitting readings of temperature, pressure, vacuum, differential pressure, and liquid level to recording, indicating, and controlling receivers, including miniature type receivers, has been announced by the Bristol Co., Waterbury 20, Conn. Trans-



mission is by means of air pressures of between 3 and 15 psi that have a direct relation to the measured quantity.

This new type of transmitter, known as the Bristol series 650 pneumatic transmitter, uses standard Bristol measuring elements and a simple transmitting mechanism with only one pivot and no flexures. Friction and lost motion are thereby eliminated for all practical purposes. The transmitter is sensitive to extremely small changes in the measured value, as little as 0.03 percent of range, including reversal. High-speed transmission and superior control result from the use of a pneumatic relay.

The series 650 pneumatic transmitter, weighing 7½ lb, is weatherproof and can be installed in any location and will operate in any position. **T-4-1512**

AMAZING heinrich FIXTURE LOCK

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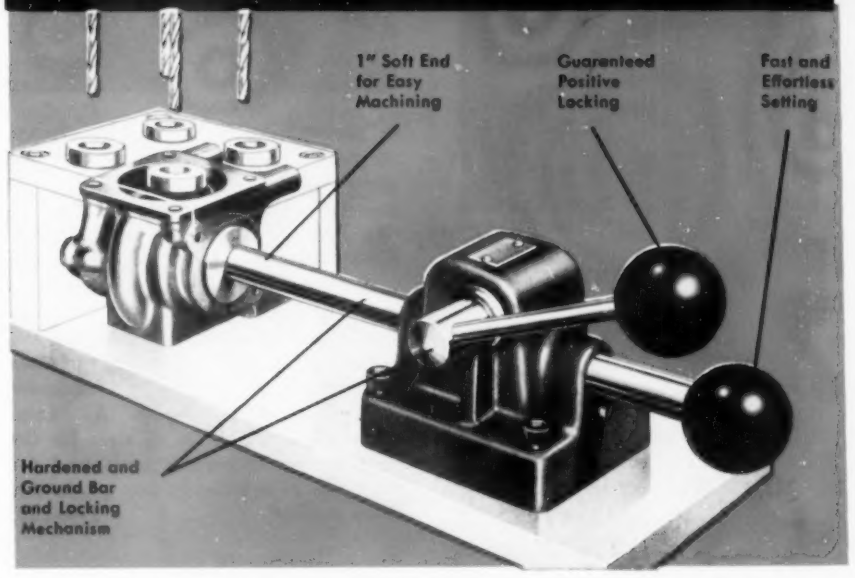
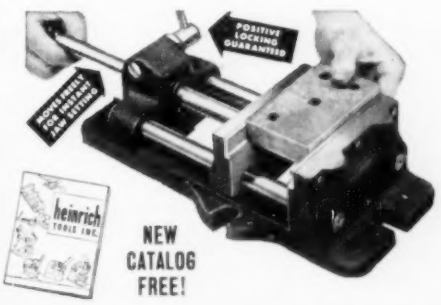

1" Soft End for Easy Machining
Guaranteed Positive Locking
Fast and Effortless Setting
Hardened and Ground Bar and Locking Mechanism

The famous Heinrich patented "Circle-Grip" locking mechanism . . . the same screwless, positive locking design proved in more than eight years of industrial use . . . is now available as the Heinrich "Grip-Master" Fixture Lock. Applicable for all types of drilling, milling operations, etc. Eliminates special locking details; simplifies jig and fixture designing; wide work clearance; no screw threads to wear out. Ask your Dealer to demonstrate it.

HEINRICH "GRIP-MASTER" SCREWLESS VISE ALSO USED AS FIXTURE BASE STRUCTURE

Enjoy savings up to 75% on tooling costs using "Grip-Master" Screwless Drill Press Vises. Instant action; just a press on locking lever and "Circle-Grip" mechanism provides a hold that hammer blows cannot break! Hardened, precision ground for long service.



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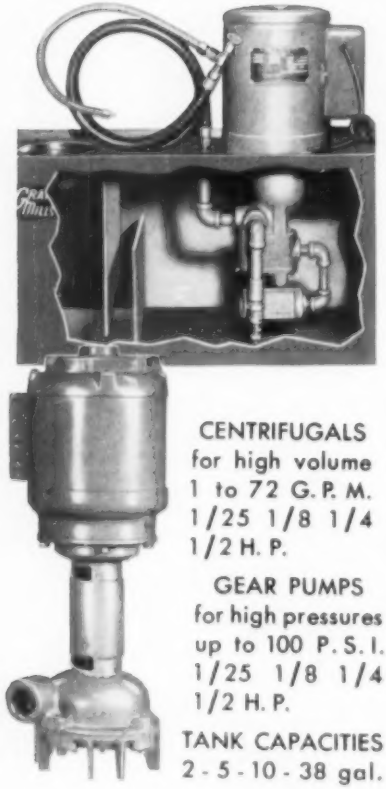

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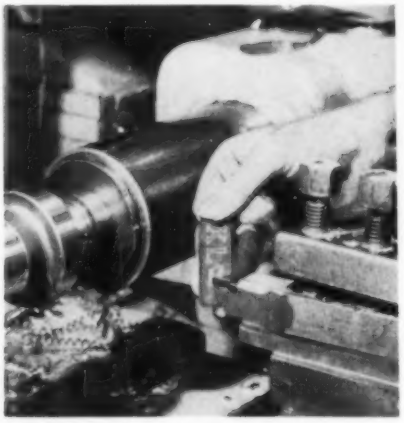
3729 N. LINCOLN AVE.
CHICAGO 13, ILL.
INDICATE A-4-152-1

Hand Hone

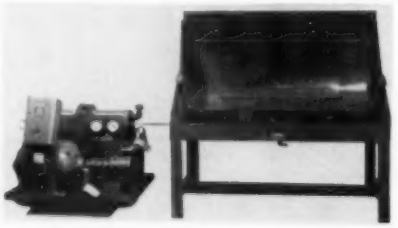
The Chicago Wheel & Mfg. Co., 1101 W. Monroe St., Chicago, announces a hand hone specially developed for on-machine sharpening of single-point tungsten carbide tools. Manufacturer claims up to 30 percent longer between-grinds tool life results when the hone is used at first signs of tool dullness. The user merely applies a few light strokes over tool edge, taking care to hold hone flat against surface so as not



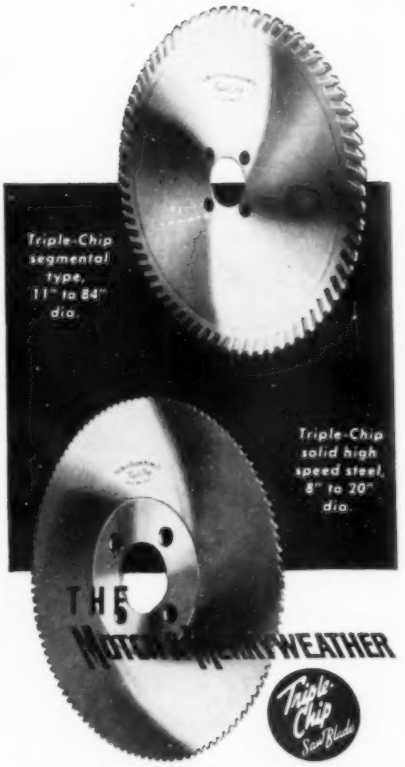
to round the cutting edge or change the relief angle. The hone quickly and effectively touches up the tool while mounted on the machine, thereby cutting down time formerly needed to remove the tool and regrind. When the tool eventually loses its original cutting angle, the manufacturer recommends a complete regrinding.

Made from silicon carbide, the hone is bonded with the maker's exclusive vitrified bonding process. XL hand hones are available in all sizes for the hand honing of carbide tools, and are available in practically any grade and grain desired. **T-4-1521**

Test Stand



A test stand for checking recoil cylinders for hydraulic pressures from 3000 to 5000 psi, has been designed and built by the J. N. Fauver Co., Inc., 49 West Hancock, Detroit 1. The equipment consists of Fauver hose assemblies, Parker fittings, Parking tubing, Marsh gages, and a 30-gal. tank. The stand has a telescopic lid and plexiglass window. **T-4-1522**



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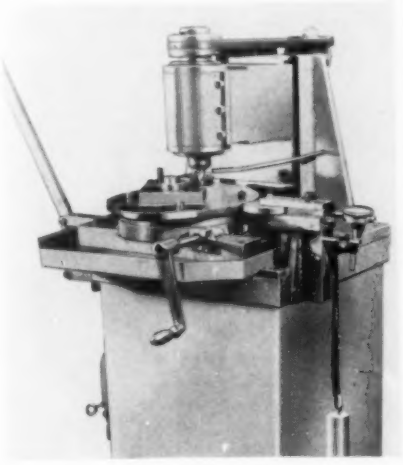
Only TM & TM builds ALL 3: CIRCULAR SAW, SAW BLADE, BLADE GRINDER

INDICATE A-4-152-2

Profile Mill

The Spike profile mill is for precision milling of profiles, irregular shapes, hexagons and geometric forms. It will hold dimensional relations to a single dimension tolerance. Cams and fixtures used on the profile mill are



built to customer specifications. The cam, precision machined, is made to a maximum capacity of the machine, establishing a ratio-relation to the machined part. Reduces tolerances by the same ratio of cam to part. The profile mill can be set up for many and various jobs by changing cams.

For further details write to Spike Mfg. Co., 24609 Middlebelt Road, Farmington, Mich. **T-4-1531**

Centering-Size Disks

Standard Gage Co., Poughkeepsie, N. Y., announces complete sets of centering-size disks whereby this gage can measure any bore within its over-all range of ¼ to ⅜ inches. Previously this #00 gage had been presented as a single-hole gage to be furnished with a centering-size disk proper for the checking of the one dimension to be specified by the user.

The set consists of 27 centering-size disks mounted on a rectangular plate with the size of each one plainly marked. The disks are interchangeable on the head and lock positively into position by the action of a clamping nut, thus insuring that the set dimension will be held.

Other features of this #00 dial bore gage are the sapphire-tipped gaging plungers and the hard chrome-plated surface of the disk. Indicator graduations are 0.0001 inch. While it is expected that the gage will be used to check very close tolerances, it will, however, cover a total tolerance as great as 0.005 inch. The gage will check to within 1/16 inch from the bottom of the blind hole. **T-4-1532**

Hot off the press

This little folder tells all about this new alloy that completely satisfies all strength and other requirements of mounting cemented carbides for heavy duty cutting tools. Write for a copy of the Trimetal folder today.

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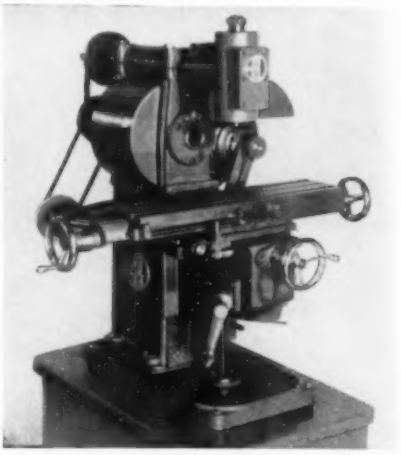
Bench Mill

A bench mill of sturdy design and great rigidity is now available. Work requiring 12-inches lengthwise, 9-inches vertical and 5-inches traverse travel is handled on its 5 x 20-inch table surface.

Special construction features provide the great rigidity. The large diameter spindle supplied with a No. 10 B&S or No. 4 Morse taper and operating at 15 separate forward or backward speeds is equipped with large Timken bear-



ings. All ways are of the dovetail type and are hand scraped. Table and knees are exceptionally wide for a machine of this size.

Milling of table T-slots from a solid insures inflexible anchoring of work itself. All screws are milled from the solid.

Work is power fed at 0.003, 0.006 or 0.012 inch per spindle revolution. A ½-hp motor is recommended. It is available with or without motor, vertical head, stand, arbors or other accessories from the Rotex Punch Co., 4726 East 12th St., Oakland, Calif. **T-4-1541**

Polishing Lathe

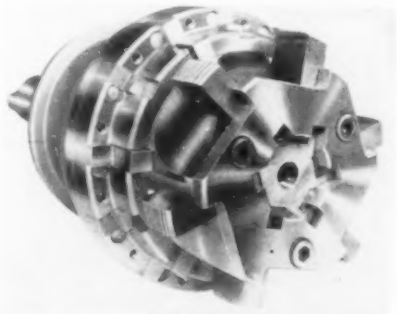
Hammond Machinery Builders, Inc., Kalamazoo, Mich., announce a 10 hp model VRO variable speed polishing and buffing lathe.

This lathe has a speed range of 1500 to 3000 rpm. Speed is changed instantly while the lathe is running by turning the dial control. It is suitable for heavy polishing and buffing operations.

T-4-1542

Tap Head

A special adaptation has been engineered by The Landis Machine Co. combining boring, counterboring, and facing blades with conventional tap chasers in a 7-inch ALT tap head.



This design affords maximum production with reductions in handling cost and capital investments as the workpiece can be bored, counterbored, faced, and tapped with one chucking, it is claimed.

The workpiece is bored, counterbored and faced with the tap chasers collapsed. Upon completion of this operation the tap is withdrawn from the workpiece and the tap chasers are expanded. The thread is then tapped on the surface previously bored. A leadscrew feed is recommended for both the tapping and boring operations to assure long tool life and a quality finish.

Certain limitations as to the diameter and design of the hole to be bored, faced, and tapped are necessarily imposed. Consultation with the maker will determine if a particular workpiece is suitable for this tooling application. Send specifications when requesting additional information. Landis Machine Co., Waynesboro, Pa. **T-4-1551**

Stabilized Fork Truck

A hydraulic-powered load stabilizer, an attachment for fork trucks with capacities up to 6000 lb., has been introduced by the Elwell-Parker Electric Co., 4205 St. Clair Ave., Cleveland 3, Ohio.

The unit is specially designed for safe transportation of unstable and semi-stable loads; it is also suitable for stable loads which are subject to rough travel where they might be bounced off the skid or pallet on which they ride. In addition to carrying loads more safely, the stabilizer will allow fork truck operators to stack at great heights with maximum safety.

Fork trucks which accommodate the stabilizer are standard vehicles; the only alteration is to the hydraulic system to regulate the operation of the attachment. The shape or size of the stabilizer plate may be altered to meet specific loads. Usually, the plate is faced with steel although it may be faced with rubber or wire mesh if desired.

The stabilizer plate is 41⅝ inch minimum, 75 inch maximum. The stabilizer is powered by a hydraulic cylinder with a pair of telescoping guides to insure smooth operation plus rigidity. The control handle of the unit is located adjacent to the operator's right hand; the pressure gage is mounted on the cowl of the truck in perfect view of the operator. **T-4-1552**

USE READER SERVICE CARD ON PAGE 137 TO REQUEST ADDITIONAL TOOLS OF TODAY INFORMATION

Cut Costs in Large Hole or Deep Hole Drilling with WAUKESHA *Inserted Blade* SPADE DRILLS

WAUKESHA *Inserted Blade* SPADE DRILLS are low in first cost. Further, each size of tool holder accommodates blades with diameter variations up to ½ inch. One holder does many jobs.

And the WAUKESHA Spade Drill body lasts for years and years. Like your safety razor you replace only the blade when finally worn out. WAUKESHA Inserted Blade SPADE DRILLS are the most practical tools for turret lathe and deep hole drilling. Both types of WAUKESHA SPADE DRILL Holders have coolant holes which assure an ample supply of coolant to flush out chips. Try WAUKESHA SPADE DRILLS in your plant. Order one today.

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Injection Molder

Development of a plastics injection molding machine was announced by Lewis Welding & Engineering Corp., Bedford, Ohio.

Features of the new machine include a multiple packing of the injection cylinder, a quick mold release for nozzle clearance and the Hydra-Lock, a new method of clamping the molds together.

The machine employs a straight bore, externally heated injection cylinder. The plastic material enters by gravity and is packed into the heating section by multiple injection strokes. This pre-packing serves to compress the material, reducing the bulk factor, and insures maximum injection of the plasticized material.

The injection of the material into the mold is compensated electrically. By proper adjustment of the control circuits, the machine is set so that the heating chamber is starved by a small amount on each stroke until it strikes a limit switch which causes its return to a point of maximum retraction.

From this point the process of progressive starving continues again and so the machine completes its feed and injection in compensated balance.

The available injection pressures are readily adjustable from practically 0 to a maximum of 20,000 psi. In special instances, this can be increased to 30,000 psi by reducing the diameter of the injection plunger.

The clamping mechanism of the machine embodies three principal elements. A toggle linkage advances the platen, on which the moving half of the mold is mounted, to a position wherein the mold faces are open only a fraction of an inch. The toggle mechanism serves as a mechanical locking device to hold the platen in the closed position.

Incorporated in the platen structure is a 16-inch diameter hydraulic cylinder, actuated automatically through the control circuits, which does the final closing of the molds and supplies the final locking pressures. The stroke of the large cylinder is so short that only a fraction of a gallon of oil and a few tenths of a second's time are required for this part of the clamping device. The high clamping pressure of 200 tons is necessary to resist the high injection pressures which the machine can develop.

The design of the Hydra-Lock clamping system gives the operator a much easier mold setting procedure. The short stroke of the clamping cylinder and the liberal clearances in the guides permit quick line-up of the mold faces. The machine will tolerate considerably more mis-alignment of the mold faces but still close and give uniform bearing across the mold. The action of the clamping cylinder is such as to provide essentially ball-and-socket action within reasonably close limits.

The molding cycle is started by the closing of the safety gate. Thereafter the platens are automatically advanced, the Hydra-Lock cylinder closes the mold and the material is injected. During the curing cycle the pre-pack of the injection cylinder takes place.

All of these operations are controlled automatically, but each element of the cycle can be adjusted to suit the particular mold in question. At the conclusion of the cycle the molds open automatically and remain open so the operator can remove the finished part. Closing the safety gate starts another cycle. **T-4-1561**

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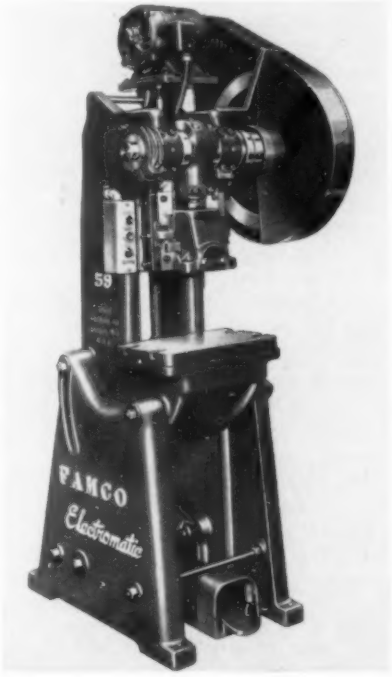
Power Press

This press features an instant-action, electrically operated, nine-point jaw clutch which combines the simplicity of electric control and the high efficiency of jaw clutches. The patent-applied-for Electromatic clutch gives this 18-ton press added versatility and ease of operation. It is activated by a touch of the foot control or optional hand controls. The manufacturer states that the simple design of the Electromatic clutch means lower maintenance costs than that with ordinary mechanical clutches.



A limit switch on the clutch housing provides absolute single stroke control. The convenient selector switch readies the press for either single stroke non-repeat, or continuous action without stopping the press. A neutral position locks the clutch in place regardless of whether foot or hand controls are activated. An electronic timer converts the press into a fully automatic machine.

The frame of the Famco model 59 is constructed of close grained, extra heavy cast semisteel. It has a one piece, heat-treated alloy crankshaft, split bronze-bushed main bearings, and greater ram area. Its semisteel flywheel is equipped with Timken tapered roll bearings. A Bijur hand oiling system is available and may be ordered installed at the factory or added later. The press is fitted with belt and flywheel guard and can be furnished with two-hand safety push button controls if desired. For further information write to the Famco Machine Co., Kenosha, Wis. **T-4-1571**

What's your problem in power motion?

There's an Anker-Holth cylinder to solve it!

● Advanced designs of Anker-Holth power cylinders in a wide range of sizes and types are available to solve your problems involving push, pull, lift or lowering action. If standard cylinders aren't the answer, Anker-Holth matches your needs with special designs.

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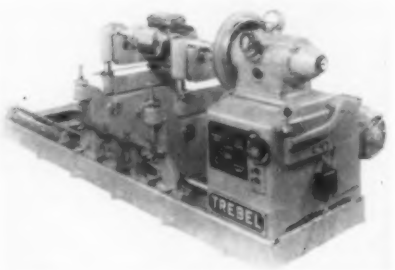
Balancing Machine

Instead of picking up the vibration of a rotating piece and then calculating the unbalance through intricate electrical networks, the Trebel dynamic balancing machine, distributed by Kurt Orban Co., Inc., 205 East 42nd St., New York 17, introduces a counter motion into the bearings in which the piece rotates until a perfectly smooth running condition is obtained. At this point the machine will indicate the magnitude as well as the location of unbalance in ounce-inches to an accuracy within 0.000025 inch displacement of center of gravity. On more specialized work, indicators in any other desired units, such as the numbers of holes to be drilled or slugs to be added, may be obtained. Through the direct indication and simple setup of the machine, unskilled operators can quickly be trained to operate this machine.



The Trebel balancing machine consists of a bed, headstock, drive motor and two independently movable supports. The latter carry open bearing rollers on which the workpiece is rotated. The height of the roller brackets is adjustable to suit different workpiece diameters. Special half-shoes for babbitt bearings or V type holders for accommodating ball bearings may also be provided. These are interchangeable with the standard roller carriages.

The electronic amplifier is housed in the headstock. It incorporates a filtering unit and a rectifier and serves the purpose of showing the most minute unbalance vibrations.

The positive drive is made possible by the use of a carrier band on the face plate of the headstock, which engages a simple driving dog on the workpiece. Plane selectors are placed underneath the previously determined planes of compensation of the workpiece. At these plane selectors a cam introduces the counter-vibration which is transmitted through a spring to the nodal bar and then to the bearing supports.

Two handwheels, one for angle, the other for magnitude, control the counterforce which is introduced into the bearings on which the work rotates. By turning the wheels the counter force is varied to neutralize the force of unbalance.

The balancing machines are available in 11 models with capacities for work weighing ¼ to 22,000 lb. and 7 to 78 inch OD models for balancing impellers and other large diameter work are available with capacities ranging from 2 to 22,000 lb. and 37½ to 98½ inch OD.

T-4-1581

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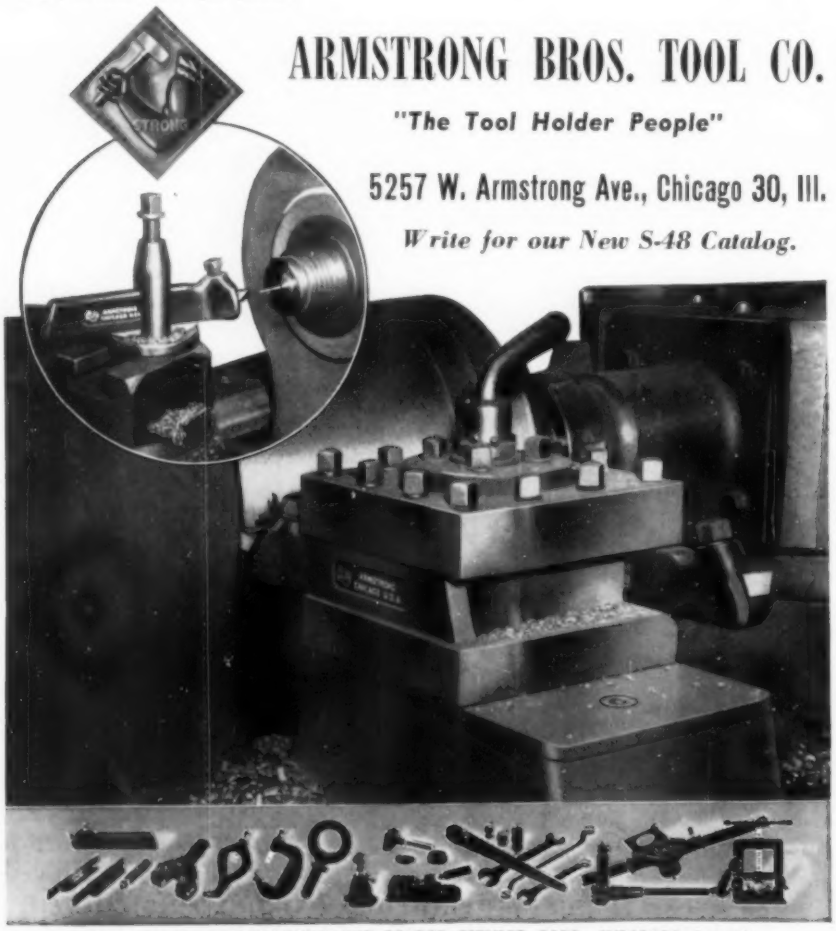
TOOL HOLDERS

for every operation!

There are ARMSTRONG TOOL HOLDERS in sizes and types for every operation on lathes, planers, slotters and shapers—for the heaviest cuts; for the most delicate cuts. With Standard shaped cutters, bits and blades of ARMSTRONG HIGH SPEED, ARMALOY (Cast Alloy) and ARMIDE (Carbide-Tipped) they provide a system of tooling that assures maximum production per machine hour, lower tool costs, and higher machining profits.

These permanent multi-purpose tools can be picked up as needed from your industrial distributor. Use them wherever possible to increase number of pieces per hour, to lower cost per pieces.



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Cast Iron Shapes

Over fifty sizes of normalized cast iron tooling standard shapes are available in 18 inch lengths. These basic shapes can be used singly or as a group and come in round flats, rectangular flats, angle sections, channel sections, H sections and also I sections. The angle sections all have the ends boxed.

Except for the ends, all of these shapes are finish ground on all outside surfaces and are ground flat, parallel and square, and to close measurements.

These normalized cast iron shapes are designed and manufactured for the use of the tool making industry and are important for jig and fixture building, as well as tooling and other special machine applications.

A shape chart and price list may be secured by writing Great Western Steel Co., Inc., 1011 East 61st Street, Los Angeles 1. Hoyland Steel Co., Inc., 4105 Lexington Avenue, New York 17, or Metal Parts and Equipment Co., 4215 Live Oak St., Dallas, Texas.

T-4-1582

Good Reading

A GUIDE TO SIGNIFICANT BOOKS AND PAMPHLETS OF INTEREST TO TOOL ENGINEERS

THE SCIENCE OF FLAMES AND FURNACES, *by M. W. Thring. Published by John Wiley & Sons, Inc., 440 Fourth Ave., New York 16.*

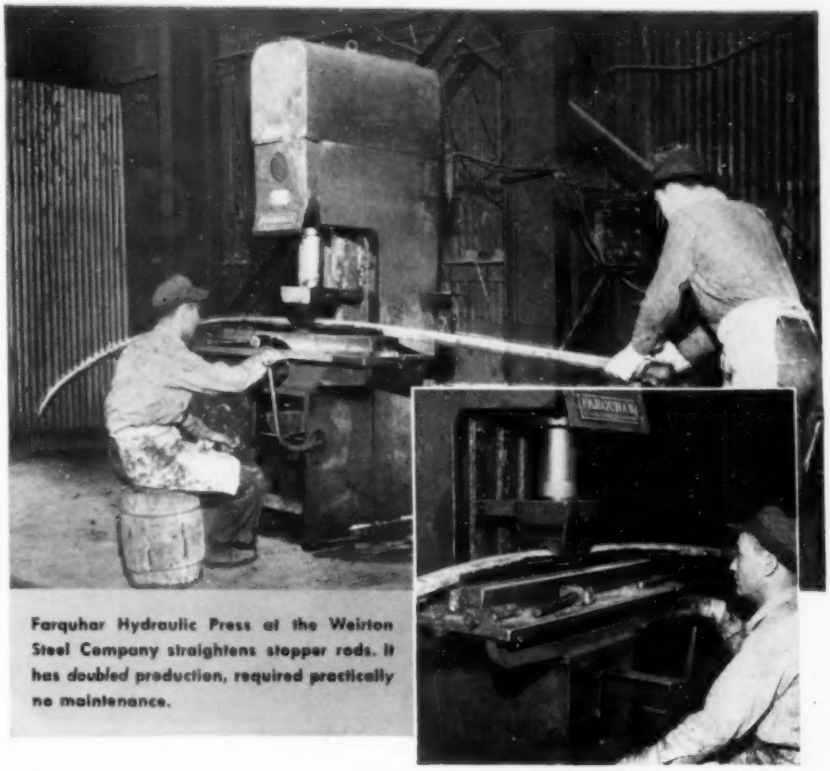
In this book the stress is put on the gap between such fundamental sciences as physics, chemistry and physical chemistry and industrial design and use. The author feels that a greater use of the science of thermodynamics in furnace design can lead to a more accurate and clearer way of thinking about such problems as those of preheat, use of waste heat, recirculation and flue gases and different qualities of fuel. He has therefore included here a digest of such of the more fundamental work on these sciences as is likely to have immediate or ultimate application to furnace design.

Particular attention is paid to the diagnosis of the ailments of existing furnaces since this will always be an important branch of the scientific approach to the subject, since the calculations on which the furnace is designed must always involve many uncertain assumptions, e. g. those connected with the behavior of the very complicated solid, liquid and gaseous materials handled.

The book includes a dicussion of those furnaces only which are heated by flames and does not deal with methods of handling the material to be heated except as it is incidental to the furnace design itself.

PRECISION MEASUREMENT IN THE METALWORKING INDUSTRY. *Prepared by the Department of Education of International Business Machines Corp. Published by Syracuse University Press, Syracuse, N. Y. Price, $6.50; 365 pp.*

This book deals with the fundamentals of precision measurement. It is a revised and consolidated version of material published previously. Based on the accumulated experience and knowledge of the IBM department of education, the volume contains a description of the most widely used measuring devices along with detailed operating procedures. All pertinent information from previous editions has been retained; new information has been added to bring the information up to date; new illustrations show important changes in instruments. In addition, it also reflects the cumulative know-how of both the civilian and military users of precision instruments.



Farquhar Hydraulic Press at the Weirton Steel Company straightens stopper rods. It has doubled production, required practically no maintenance.

Farquhar Hydraulic Press
at the Weirton Steel Co.

"eliminates breakage of rods... increases production 100%"

The Weirton Steel Co., Weirton, W. Va., formerly straightened stopper rods with a steam hammer. The operation was slow and resulted in a high percentage of breakage. Seeking a better method, Weirton officials bought a Farquhar Press to speed production. Not only has the press increased production 100%, but it has eliminated breakage of rods. In addition, Weirton reports that in the six years this press has been operating, "practically no maintenance has been necessary."

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Farquhar engineers are ready to help solve whatever production problem you may have. Send for free catalog showing Farquhar Built-for-the-Job Presses in all sizes and capacities. Write to THE OLIVER CORPORATION, A. B. Farquhar Division, *Hydraulic Press Dept.*, 1519 Duke St., York, Pennsylvania.

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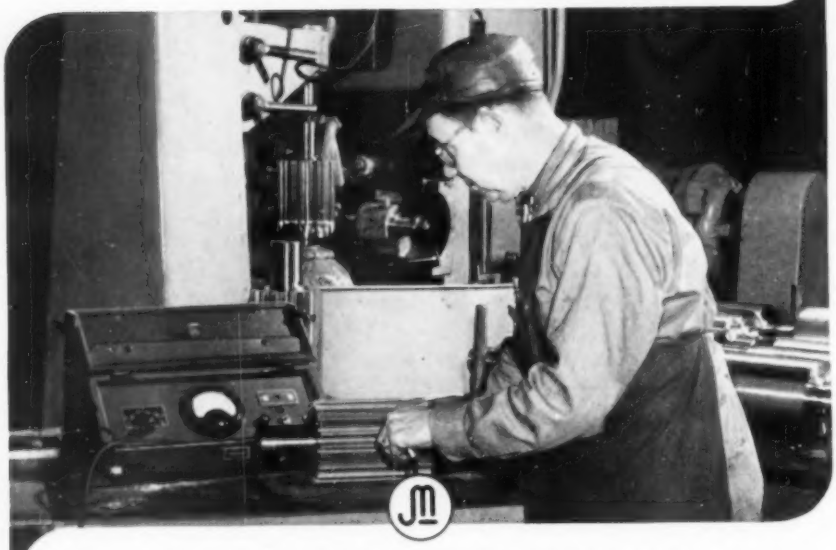

the JEFFREY MANUFACTURING CO.
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The Jeffrey Manufacturing Company of Columbus, Ohio is the largest plant of its kind in the world manufacturing mining, processing and handling equipment. From the first stage of manufacture of this equipment the Jeffrey Company relies on the Profilometer.

At Jeffrey, the Profilometer is used to establish precision surface specifications from the blue print stage of parts manufacture to the actual holding of precision surface measurement at the machine in the shop.

In the above illustration the Profilometer is shown checking the surface finish of idler gears after hobbing. These gears are used in the lower gear housing of Jeffrey's famous continuous mining machine, the COL-MOL, and must be held to a surface finish of 50 microinches or less. With the Profilometer on-the-job surface measurement is possible in seconds assuring constant quality control and eliminating the possibility of costly rejects due to improper surface finishes.

To be *sure* of precision surface measurements, plants throughout the world are relying upon the Profilometer today. In your production and inspection departments you also can obtain the exceptional advantages of the Profilometer as an important shop tool.

To learn how the Profilometer can help cut costs in your production, write today for these free bulletins . . . Practical Operating Features of the Profilometer; How to Specify Surface Roughness And Why.

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FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-160

Who's Meeting - and Where

Mar. 31-Apr. 2. The Magnesium Association. International exposition, National Guard Armory, Washington D.C. Write association offices, 122 E 42nd St., New York 17, for more information.

Apr. 7-9. Lead Industries Association. Annual meeting, The Greenbrier, White Sulphur Springs, W. Va. Write association's office, 420 Lexington Ave., New York for full information.

Apr. 8-10. Society of the Plastics Industry, Inc. Pacific Coast conference, Last Frontier Hotel, Las Vegas, Nevada. Get particulars from society office, 67 W. 44th St., New York 36.

Apr. 9-10. Malleable Founders' Society. Market development conference, Cornell Univ., Ithaca, N. Y. For more details, contact society headquarters, Union Commerce Bldg., Cleveland 14.

Apr. 11-21. Swiss Industries Fair. 37th Annual Industrial Exhibition, Basel, Switzerland. Mr. O. Goetz, Commercial Counselor, Consulate of Switzerland, 75 E. Wacker Dr., Chicago 1, can supply all particulars.

Apr. 12-15. American Supply & Machinery Manufacturers Association. Annual meeting and conference booth program, Hotel Columbus, Miami, Fla. Write association headquarters, 814 Clark Bldg., Pittsburgh 22, for information.

Apr. 12-16. Electrochemical Society. Spring meeting, Statler Hotel, New York. Contact society headquarters for details, 235 W. 102nd St., New York.

Apr. 13-15. American Society of Lubrication Engineers. Eighth annual meeting, Hotel Statler, Boston, Mass. Details are available from society offices, 343 S. Dearborn St., Chicago 4, Ill.

Apr. 13-15. International Acetylene Association. Annual spring meeting, Hotel Biltmore, Atlanta. Contact the association office, 30 E. 42nd St., New York 17, for details.

Apr. 14-15. Westinghouse Electric Corp., sponsoring the 17th annual Machine Tool Electrification Forum, Hotel Statler, Buffalo, N. Y. First day's session at Hotel Statler, Buffalo; second day's session at Motor and Control Div., Westinghouse.

Apr. 14-16. Conveyor Equipment Manufacturers Association and University of Illinois Department of Engineering. Conveyor institute at the University, Champaign.

Apr. **16-19.** GRINDING WHEEL INSTITUTE. Spring meeting, The Homestead, Hot Springs, Va. Get more information from institute office, 2130 Keith Bldg., Cleveland 15.

Apr. **20.** SOCIETY OF AUTOMOTIVE ENGINEERS, INC., conducting an Aeronautic Production Forum to take place simultaneously at Hotels Governor Clinton and McAlpin, New York City. Contact SAE headquarters, 29 W. 39th St., New York 10 for more information.

Apr. **27-May 8.** BRITISH INDUSTRIES FAIR. Exhibition of consumer goods at Olympia and Earls Court in London and of heavy industrial goods at Castle Bromwich, Birmingham, England. Write British Information Services, 30 Rockefeller Plaza, New York 20.

Apr. **30-May 1.** OAK RIDGE INSTITUTE OF NUCLEAR STUDIES. Symposium on "Management Problems in Industrial Application of Radio Isotopes" to be conducted by Institute's Special Training Div. Additional information and application blanks are obtainable from the Division office, P.O. Box 117, Oak Ridge, Tenn.

THREE COMPANIES UNITE INDUSTRIAL EFFORTS

Three manufacturing and engineering organizations have affiliated in Glen Cove, N. Y., under the name of The Pall Filtration Companies with an aim of providing industry with engineering, production and research services in the fields of filtration and porous media. The activity is under the leadership of Dr. David B. Pall, well known in the development of porous metals, alloys, and plastics, in sheet and fabricated form.

The firms concerned are the Micro Metallic Corp., Aircraft Porous Media, Inc. and Porous Plastic Filter Co. Micro Metallic concentrates on production of porous stainless steel and other metals and alloys, and the fabrication of filters for a wide range of uses in chemical process and other industries.

The second company, which has produced a new high tensile strength, smooth surfaced porous stainless steel for major aircraft applications, will continue in the development of aircraft leading edges for deicing and boundary layer control; fuel, lube and hydraulic oil filtration; and transpiration cooled devices.

Porous Plastic is now completing production facilities for porous Teflon and Kel-F in sheet and fabricated forms on which a research department has been organized under Dr. Pall's supervision to round out the new organization. Already it is at work on new developments in the fields of porous media and filtration.

BOOST SCREW MACHINE OUTPUT 60% to 100% . . . EVEN MORE!

LIPE
Automatic
Magazine Loading
BAR FEED

Suppose you could run your screw machine continuously—get a *full* 8-hour-day production—with no time lost for loading, replacing feed fingers, cutting air or idle operation. How much would your production go up? 10%? 20%?

Revise your estimate—you're way low. By converting lost time into productive time in hundreds of plants, *Lipe Automatic Magazine Loading Bar Feeds* have increased output 60% to 100%. One user reports a production increase of 221%!

WHAT A LIPE AML BAR FEED WILL DO FOR YOU:

Feed tubes or bars automatically, continuously.

Abolish feed fingers—eliminate time lost in making feed finger adjustments.

Feed stock up to 16" long in one feed-out operation—save the time lost with multiple feed finger feed-outs, thus cutting cycle time.

Reduced cycle time increases gross geared production capacity of screw machine.

OUR UNCONDITIONAL GUARANTEE:

Lipe AML Bar Feed will enable your screw machine to produce at least 90% of its gross geared capacity.

• Interested? Send for folder describing AML Bar Feed — operation, benefits, case histories.

LIPE ROLLWAY — *Lipe* – ROLLWAY CORPORATION
Manufacturers of Automotive Clutches and Machine Tools
Syracuse 1, N. Y.

Technical Shorts...

A RECENT DEVELOPMENT in the application of hidden arc or submerged arc welding, is said to increase the speed of automatic welding by 50 percent or more. Welding, as The Lincoln Electric Co. calls its method, employs two small electrodes in place of a single larger electrode. They are fed simultaneously through a single head and a single jaw. Both electrodes deposit metal in the weld crater. This leads to considerable advantages in some situations since higher currents possible with two electrodes increase the rate of metal deposition, amount of penetration and, consequently, welding speeds.

The company recommends for use on butt or fillet welds plate, 4¼ inches or thicker, where the application is normal for automatic hidden or submerged arc welding. Typical of the speeds possible is that used in making a ¾-inch fillet weld—15 inches per minute at 1500 amperes.

A special electrode jaw, wire feed rolls and wire guides adapt any standard Lincoln weld head for using two electrodes. The standard single head controls are used as well as the standard d-c welding current generators. Currents up to 1500 amperes can be used with Twin-arc welding for which two generators may be paralleled or a single 1500-ampere unit may be used. The two-wire head will feed electrodes in 5/64 inch, 3/32 inch and ⅛-inch diameter sizes. The electrodes are fed down into the Twin arc jaw where the welding current is conducted into each electrode from the same contact block. The electrodes are pressed against each side of this contact block which determines the electrode spacing. Normally, this spacing is ½ inch, but it can be adjusted where necessary. Both electrodes are regulated equally by the common arc voltage control. The welding current from the common welding generator automatically divides between them.

The electrodes normally are in line along the seam but may be skewed ⅛ inch so that they are across the seam, producing a wider bead. If a still wider bead is desired or if burn-through is a problem, the electrodes can be run side by side. This is recommended especially for poor fit-up.

In addition to increasing the speed of automatic welding, twin arc welding is said also to facilitate welding on rusty or dirty plate, producing quality welds where normal single arc technique would result in pinholes. The two arcs and resulting larger crater allow time for gases in the crater to be expelled.

* * *

AN AMBITIOUS IDEA which developed into an important working project is the Heat and Mass Flow Analyzer Laboratory at Columbia University. One of the service divisions of the School of Engineering, the name comes from the main part of its equipment—a computing device developed continuously in the laboratory over a period of years.

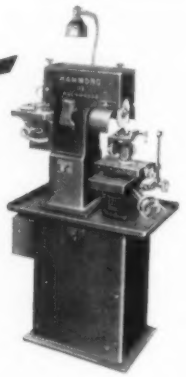
Prime work of the researchers there is the study of heat diffusion and flow problems. At the same time, their equipment may be adapted, with minor changes, for the solution of problems in other fields such as stress analysis and fluid flow.

Most of industry has to contend with problems concerning heat, its transfer, control, etc. For example, how must heat generated by moving parts be dealt with? In the metallurgy field, the troubles are myriad. However, although these problems are almost universal in greater or lesser degree, most companies do not have heat transfer specialists on their staffs.

It is in this connection that the Laboratory fills considerable need. It may do a research project, either individual, cooperative or group. It may make demonstrations or conduct training programs.

Created 12 years ago, the laboratory has developed, as a nonprofit service, into an outstanding example of practical cooperation between science and industry. Recently it completed an expansion program necessitated by its increased work requirements.

Hammond
OF KALAMAZOO
CARBIDE TOOL
AND
CHIP BREAKER GRINDERS



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TIME
TOOLS
WHEELS

CB-77 Chip Breaker and Diamond Finishing Grinder

WD-10 Wet or Dry 10" Carbide Tool Grinder

14-WD Wet or Dry 14" Carbide Tool Grinder

Hammond Carbide Tool Grinders will soon pay for themselves thru greater wheel economy, longer tool life and FASTER grinding. They relieve toolroom bottlenecks and step up production. Write for Carbide Grinder Catalog 225.

Hammond Machinery Builders INC

1661 Douglas Ave. • Kalamazoo, Mich.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-162

To better acquaint the industrial public with its work and the possibilities it offers, the Laboratory has just published a complete informative brochure. It may be obtained by writing, on company letterhead, to Dr. Victor Paschkis, technical director of the Heat and Mass Flow Analyzer Laboratory, 624 Engineering Bldg., Columbia University, New York 27.

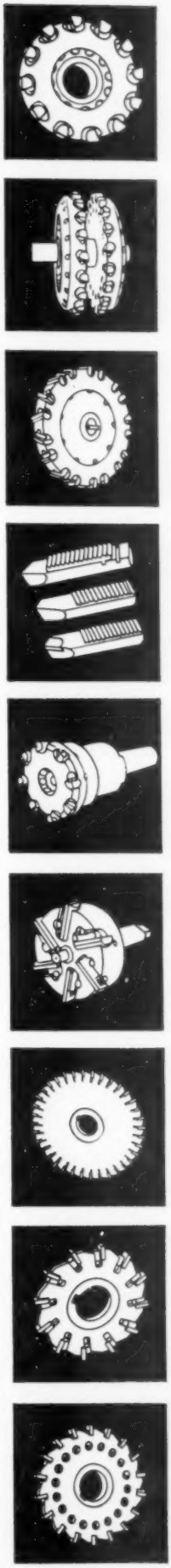
* * *

DEVELOPMENT of a new high capillary silver-bearing stainless steel solder which can be applied with a soldering iron or torch at 430 degrees F. has just been announced by All-State Welding Alloys Co., Inc., White Plains, N. Y.

Researchers found that on a wide variety of work, particularly on steel, stainless steel, copper, and nickel alloys, a stronger "soft" solder would greatly reduce the need for the costlier materials and methods of brazing. Extensive field tests demonstrated that silver-bearing stainless steel solder has gone far in that direction. Claims are that it costs much less than the silver brazing alloys, is easier and cheaper to apply, and that it has somewhat the same affinity for all metals. In working with it, conclusions were that thin layers are strongest. At the same time it shows a favorable comparison to the other silver alloys, in its adaptability to standard manufacturing, installation, and maintenance procedures. In addition it can be chrome plated.

Listed as All-State No. 430 Silver-bearing Stainless Steel Solder, it contains neither lead, zinc, nor cadmium. Actual physical properties vary with base metal, depending on strength of the interalloy layer. Therefore, properties in the following test data apparently are derived primarily from its silver content and the interalloys formed between different metals. Copper to copper: Tensile—14,300 psi; shear—11,200 psi; elongation in 2 inches—21 percent. These facts are of interest when compared to average physicals on interconnecting stainless, copper, brass, etc.: Tensile—10,000 to 28,000 psi; shear—10,000 to 15,000 psi; elongation in 2 inches—1028 percent.

Characteristics of the deposited solder include color that closely matches stainless steel and that remains stable. The deposit is nontoxic and is not brittle. Movement of the plastic joint does not affect solidus strength as in the case of lead tin solders. Recommended applications are broadly described as high-conductivity electrical connections, corrosion-resistant assemblies, and fabrications to operate at temperatures too high for lead-tin solders.



8 REASONS WHY...

Lovejoy Cutters are your best buy!

Lovejoy milling cutters offer eight important advantages which help you achieve maximum accuracy, dependability, production and profit from your milling machines.

1 All Lovejoy cutters are insert-tooth type. This means high body strength, plus maximum blade hardness. Only worn out blades need be replaced—*not* the entire cutter.

2 Serrations are on the front of each blade — the plain back makes full contact with the body.

3 Positive-locking device on blades assures complete rigidity, even on heavy intermittent cuts.

4 Advancing, replacing and sharpening of blades is fast and accurate, keeps down-time at an absolute minimum.

5 Extra rugged blade and body design assures maximum results on modern, high-speed millers.

6 H. S. S., alloy and carbide-tipped blades are available promptly from stock.

7 Lovejoy design is tops for blade interchangeability in practically all cutter styles and sizes.

8 Lovejoy has had 35 years of experience in designing and manufacturing standard and special cutters for the country's leading manufacturers—our background can help *you* get best results from *your* milling operations.

Write for free catalog!

131 MAIN ST., SPRINGFIELD, VERMONT

LOVEJOY TOOL COMPANY, INC.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-163

North East West South IN INDUSTRY

The Bradley Stoughton plaque has been awarded to **C. B. Post,** Chief metallurgist at **The Carpenter Steel Co's** Research and Metallurgical Laboratories. The plaque is presented by the American Society for Metals to the Lehigh Valley metallurgist who has accomplished the most outstanding and generally useful metallurgical work. This is the third such award to have been made to Carpenter's metallurgical personnel.

F. Steel Blackall, III, has been made assistant general manager of **The Taft-Peirce Mfg. Co.** Mr. Blackall is also assistant treasurer and a director.

Kilbourne Knox, Jr., who for several years has been senior designer on hydraulic equipment with the McDonnell Aircraft Corp., has joined **Parker Appliance Co.** as staff engineer in charge of engineering in connection with the company's program on aircraft hydraulic equipment.

Robert E. Anderson has been named president of **Robertson Mfg. Co.** Joining the company as ceramic engineer 31 years ago, Mr. Anderson held successively more responsible positions including those of factory manager and executive vice-president. He succeeds **D. P. Forst,** now board chairman.

P. D. Q.
(PORTAGE DOUBLE-QUICK)

Changes from one tool to another is a matter of seconds. Three point locking feature and tapered shank assures repositioning and eliminates "run out." Send for catalog describing individual holders and adapters or for specific information on your machine tools.

PORTAGE Double-Quick TOOL CO.
1054 Sweitzer Avenue • Akron 11, Ohio

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-164

The **U. S. Drill Head Co.** elected new officers recently as a result of change in ownership. **A. P. Speckin** former vice-president and general manager of the company, became its president; **J. R. Bashor,** its vice-president and **W. K. Francis,** its secretary and treasurer. **W. C. Moening,** former president of the firm, was elected chairman of the board.

According to a recent announcement from **Temco Aircraft Corp., Walton M. Dallas** has been named manager of manufacturing control where he will be in charge of master scheduling, change control, estimating, manufacturing analysis as well as numerous other functions. He formerly was superintendent of manufacturing control.

W. M. Dallas

W. C. Strauble

According to a recent announcement, **Wilbur C. Stauble** has been elected president of **The Holo-Krome Screw Corp.** and a director and member of **Veeder-Root, Inc.** The positions were formerly held by United States Senator William A. Purtell.

Responsibilities of **L. A. Dixon,** executive vice-president of **Rockwell Mfg. Co.,** have been expanded to include jurisdiction over the company's power tool operation. As executive administrator of Rockwell's 19 plants, Mr. Dixon will be responsible for manufacture and sale of the company's diversified line.

According to a recent announcement, **Dr. Arthur A. Brown** has been appointed vice president of **Bowser Technical Refrigeration,** Terryville, Conn. He was formerly associated with Pratt & Whitney Aircraft Div., United Aircraft Corp.

William J. Darmody (Col. U.S. Army, Ret.), well-known ordnance gage expert, has joined **The Sheffield Corp.** as part time consultant. Prior to his retirement from the army, he spent years as chief of the gage department at Frankford Arsenal for Army Ordnance gage laboratories, gage design and supply on a national basis.

Henry F. Arndt has been named chief engineer of the **Detroit Electric Furnace Div., Kuhlman Electric Co.** All matters pertaining to specifications, design and general engineering functions of the division will be under his supervision. At the same time, **Joseph F. Przygocki** was assigned the production and control functions for the division; his duties to include direct supervision of service order scheduling and writing.

Paul D. Cornelius has been appointed to head the design and research department of **Vlier Engineering, Inc.** Mr. Cornelius comes to Vlier from J. O. Mfg. Co., where he was chief engineer. His wide background in tool and machine research, includes particularly developments of tool for the oil industry. In his new association, he will continue the development of Vlier machine tool specialties.

P. D. Cornelius

R. J. Keller

According to a recent announcement, **Russel J. Keller** has been made engineering assistant to the president of **Cleveland Welding Co.**, subsidiary of **American Machine & Foundry Co.** Mr. Keller formerly was technical supervisor of the aircraft wheel and brake division of B. F. Goodrich Co. In his new position, he will supervise all production and development engineering.

The board of directors of **Titeflex, Inc.** have made a number of announcements recently concerning personnel changes at that company. **Henry S. Elder,** who has served as vice president since joining the company in 1946, now is executive vice-president. **George K. Licht,** formerly works manager, became vice-president in charge of production at the company's two plants in Newark, N. J. **John J. Phillips,** who previously was chief engineer, now is vice-president in charge of sales, in which position he will consolidate and coordinate the company's sales activities with its engineering operations.

The **Roberts Numbering Machine Co.** has announced the appointment of **N. M. Olney** as plant superintendent. Mr. Olney brings to Roberts more than 20 years' engineering and manufacturing experience with tooling and production of small interchangeable precision metal products.

Former Secretary of Commerce **Charles Sawyer** has been elected a director of **Kennecott Copper Corp.** In addition to his long and distinguished career in public service, Mr. Sawyer has extensive experience in business and the practice of law. More recently, an announcement also made from Kennecott named **Paul B. Jessup** assistant treasurer. Mr. Jessup, who also is a member of the board of directors of the American Mining Congress, resigned as vice-president of Day Mines, Inc., to join Kennecott.

The Turchan Follower Machine Co. has announced three promotions in management. **Gales S. Humes** has been named general manager; **Otto C. Turchan,** sales manager; and **Demeter Kiurski,** chief engineer.

OBITUARIES

Samuel Koffsky, chief engineer of **Simmons Machine Tool Corp.** for 16 years, died recently in Albany, N.Y. Mr. Koffsky played a leading role in Simmons' machine tool designing and rebuilding work during World War II and in the current defense program.

Theodore Bausch Drescher, a vice president of **Bausch & Lomb Optical Co.** and a grandson of one of its co-founders, died unexpectedly of a heart attack at his home in Rochester, N.Y. He was 58. Mr. Drescher had been in charge of the firm's process development program since 1946 and recently viewed the completion of the new single vision lens plant.

INGERSOLL'S NEWEST

58-Spindle Process Machine

MILLS AND BORES 90 AUTOMOBILE CYLINDER BLOCKS PER HOUR

Seven kinds of milling cutters, together with boring tools and chamfering bars, fixtures and transfer equipment, were built by Ingersoll as integral parts of the process line pictured above.

Working with our machine designers to meet exacting production and accuracy requirements of the automobile industry, Ingersoll's cutter engineers are continually improving basic tool designs.

Application of these advances to our standard inserted blade cutters makes higher feeds, longer tool life, and increased production available for all kinds of work on all makes of milling and boring equipment.

Write for NEW INGERSOLL Cutter Catalog 60F

THE INGERSOLL MILLING MACHINE CO., ROCKFORD, ILLINOIS, U. S. A.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-165

TRADE LITERATURE

Free Booklets and Catalogs Currently Offered By Manufacturer

Pumps

Eight-page bulletin 160-26 describes complete line of Pioneer and Rollway pumps; illustrates centrifugal equipment for coolants, cutting oils, etc., with drawings and photos to clarify typical installations on different machine tools as well as illustrating other accessories; cutaway views show advantages of both seal and sealless types. Also shows positive displacement pumps for lubricating oils and other liquids with application photos. **Pioneer Pump & Mfg. Co.**, 19657 John R St., Detroit 3.

L-4-1

Materials Handling

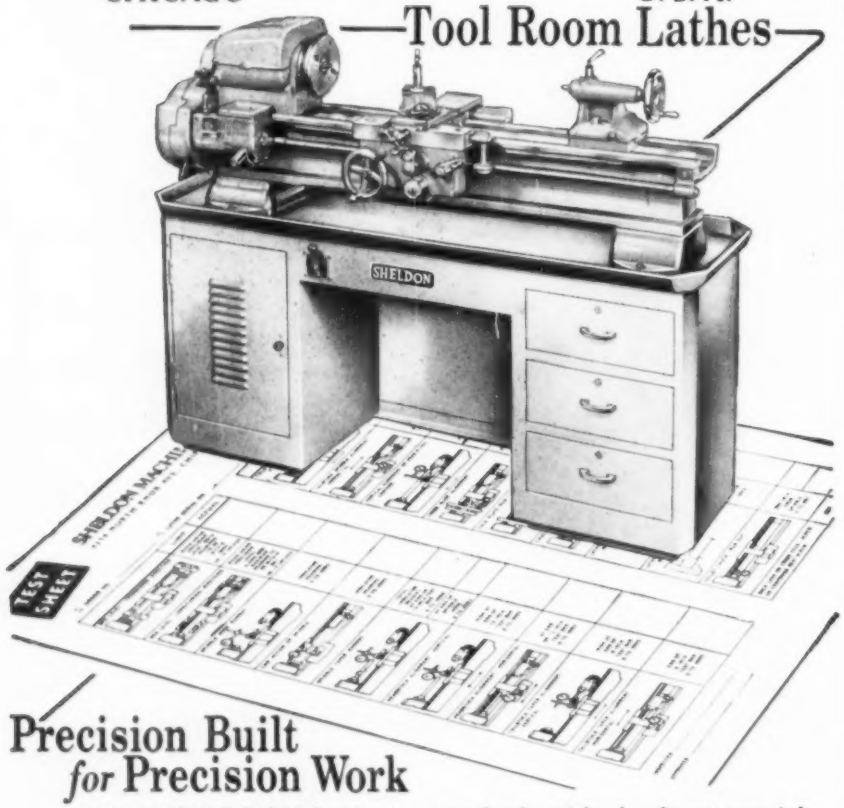
Six-page materials handling study, "There's an Angle to Increasing Existing Storage Space," shows warehouse operators and manufacturers how oblique stacking cuts down aisle requirements, increasing storage capacity and simplifying inventories; charts illustrate how variables of layout, building problems, pallet sizes and fork truck capacities affect planning. Case histories included. **The Baker-Raulang Co.**, Baker Industrial Truck Div., 1230 W. 80th St., Cleveland 2.

L-4-2

SHELDON

CHICAGO U. S. A.

—Tool Room Lathes—



Precision Built *for* Precision Work

Each SHELDON Lathe is a precision machine tool that in final inspection has passed the 19 accuracy checks on the SHELDON "Inspection Test Sheet."

Produced by modern methods with the finest special machines, these 10″, 11″ and 12″ (swings 13″) lathes are quality built on a quantity production basis. Selling at quantity production prices they are today's best lathe values.

Write for Catalog with Check Chart

SHELDON MACHINE CO., INC. 4229 North Knox Ave., Chicago 41, Illinois

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-166

Thread Comparator

Eight-page folder presents thread gaging equipment and explains and illustrates problems related to manufacture, inspection and use, of screw threads; and how to cope with them. **Johnson Gage Co.**, Bloomfield, Conn.

L-4-3

Transformer Laminations

Fifth edition of transformer lamination catalog includes up-to-date technical information and full-size drawings of available standard shapes; weight tables accompany descriptions of each lamination to assist in ordering. **Allegheny Ludlum Steel Corp.**, 2020 Oliver Bldg., Pittsburgh 22. **L-4-4**

Metal Processing

Two bulletins, "Annealing of Malleable Iron" and "Heat-treating Equipment for Aluminum"—GEA-5797 and GEA-5912 respectively—are the first two in a Modern Metal Processing series to be released by the company. The first illustrates and explains how to cut down over-all costs and how to shorten annealing cycles; discusses effects of temperature, types of furnaces to be used, and outlines analysis of annealing costs. The second booklet describes process of solution heat-treating, annealing, aging and stabilizing of aluminum; illustrations clarify technique step by step, covering the process, equipment and furnace selection. **General Electric Co.**, Schenectady 5, N. Y. **L-4-5**

Cutters

Fully illustrated 72-page booklet deals with inserted blade milling and boring cutter for all makes of equipment; includes extensive material on carbide milling of steel, proper selection of tools, cutting methods and cutter grinds for all kinds of work; in addition, describes company's line of standard cutters including shear clear face mills. **The Ingersoll Milling Machine Co.**, Rockford, Ill. **L-4-6**

Clamping Tools

Widely illustrated general catalog No. 109 covers line of vises, clamps, work positioners and other hand tools; may be considered a reference book since it includes Federal Specification references and other technical data important to the field. **Wilton Tool Mfg. Co.**, 925-41 Wrightwood Ave., Chicago 14.

L-4-7

Stampings

Comprehensive 12-page booklet deals with company's facilities and activities; tells in words and pictures how their basic method can be utilized to fill requirements brought about by short runs of metal stampings. **Dayton Rogers Mfg. Co.**, Minneapolis 7, Minn. **L-4-8**

Gaging

Twelve-page booklet describes advanced methods of optical gaging to cut inspection and toolroom costs; illustrates uses of special fixtures and charts for inspection to close tolerances, large parts, complex shapes, blind holes and recesses using contour projection. Well illustrated. Industrial Optical Div., **Eastman Kodak Co.**, 343 State St., Rochester 4, N. Y. **L-4-9**

Collets

Comprehensive 26-page catalog No. 18 covers line of collets; includes section devoted entirely to specifications and prices of collets, feeders and pads for automatics, hand machines, turret lathes, milling machines, production and engine lathes; also illustrates and describes some of company's special types pointing out exclusive features and their advantages. **Sutton Tool Co.**, Sturgis, Mich. **L-4-10**

Thread Gages

Handy condensed pamphlet covering line of precision thread plug and thread ring gages, contains informative and useful data on gages and gage standards for the man requiring essential facts in compact and easily accessible form. **Standard Thread Gage Co.**, 26538 W. Seven Mile Rd., Detroit 19. **L-4-11**

Drill Presses

Illustrated catalog No. 5206 covers complete line of drill presses; photos and line drawings clearly explain main features; includes drill press attachments manufactured and supplied by the company, emphasizing their advantages from the standpoint of economy, and production boosting. **South Bend Lathe Works**, 425 E. Madison St., South Bend 22, Ind. **L-4-12**

Heat Treating

Folder offers extensive information on company's 100 percent forced convection heat treating units illustrated by photos and drawings with cross-section diagrams to clarify actual operation; explains "old chain transfer" process, and "atmosphere control" methods which are exclusive features. Chart shows operation processes available with units. **Ipsen Industries Inc.**, 715 S. Main St., Rockford, Ill. **L-4-13**

Aluminum Extrusion

Complete catalog covers more than 4000 standard extruded aluminum shapes, rod, bar and tubing available from company; includes wealth of informative data to assist designers, engineers and purchasing men in selection of type for particular application. Extensive chart presents physical properties and recommended applications for the 14 most generally used alloys. **Precision Extrusions**, Bensenville, Ill. **L-4-14**

Purifiers

Bulletin 700, "End Dirt and Moisture Problems the Hi-eF Way," describes many uses of purifiers in the petroleum, chemical and other industries, as well as in steam generation and distribution systems, emphasizing economy; cutaway views show installation in 14 different applications, describing purpose of purifier in each case. Purifier Div., **The V. D. Anderson Co.**, 1935 W. 96th St., Cleveland 2. **L-4-15**

The Hyprez formula
for the right finish faster
HYPREZ
High Precision DIAMOND COMPOUNDS
The exclusive vehicle engineered for highest performance, together with scientifically graded pure diamond particles, produces superior finishes faster. . . . A complete range of grades from finest to coarsest is available.

Ask for a Free Demonstration, or Technical Bulletin No. T-453

HYPREZ DIVISION

ENGIS EQUIPMENT COMPANY, CHICAGO 5, ILL.

431 SOUTH DEARBORN ST.,

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-167

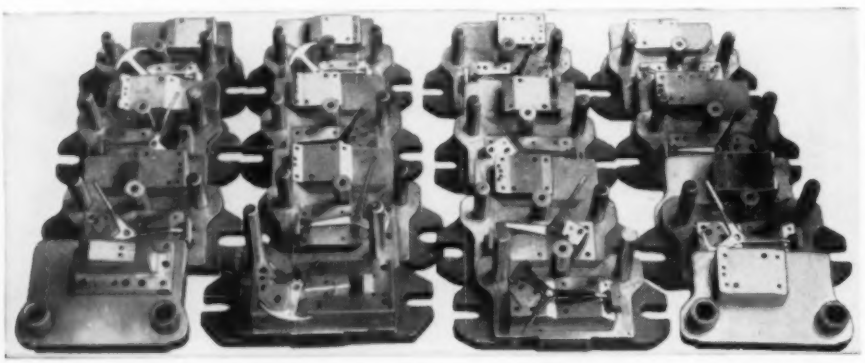
Engineers!

ELIMINATE ASSEMBLY PROBLEMS WITH . . .

PRODUCTION B. Jahn PROVED DIES

Two . . . three . . . fifty component dies can be built by B. Jahn — each production proved to guarantee one perfectly fitting, operational assembly.

Modern production requires assemblies — each component demanding a separate tool and die — each having a vital relationship — all needed when you want them. In the modern B. Jahn plant, 165 skilled tool-makers representing 3654 years of experience *work together* developing multiple dies of flawless precision for intricate assemblies.



Part of a set of twenty-eight B. Jahn built precision forming dies, to produce different component levers for one of America's largest calculating machine manufacturers. B. Jahn builds multiple dies as a team — each engineered to do a specific job perfectly.

HERE'S THE WHOLE STORY -

Send TODAY for "The Story of B. Jahn Production Proved Dies" — a fact-packed brochure illustrating B. Jahn's facilities and their production-increasing, money saving applications.

Investigate B. Jahn and Invest in Production Economy!

B. Jahn

THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-168

Abstracts of Foreign Literature

By M. Kronenberg

Optical Measuring Equipment

An optical attachment which can be used for increasing the accuracy of reading scales on machine tools is described by K. Buerger in the December 1952 issue of *Werkstattstechnik und Maschinenbau*. It is not necessary to put the eye close to the attachment, and this lessens the strain usually associated with the use of optical instruments. Scales graduated in millimeters (0.040 inch) can thus be read to an accuracy of 0.000400 inch, whereby it is possible to estimate 1/10 of this dimension. A microscope with projector likewise is discussed by the author. It can be attached to grinding machines and permits the comparison of profiled workpiece contours with magnified drawings. Angles, radii, threads likewise can be measured in this way. Magnification up to 30 diameters can be obtained.

A bench-type projector has been developed in France, as indicated in K. Buerger's article, for checking the contour of workpieces in a way similar to the adapter type for grinding machines. They are easy to handle and weigh only 40 to 50 pounds.

Checking the alignment of guideways of machine tools and the straightness of tables and other parts is one of the most important measuring jobs in tool engineering. Telescopes, which often have been used for these purposes, have the disadvantage of requiring refocussing every time the marker is moved on the bed in the measuring process. A new design eliminates the necessity of refocussing by using a curved reflector in conjunction with an objective. The instrument is used for measuring vertical and horizontal deviations from a straight line with an accuracy of about 0.00005 inch per yard length. In determining angular deviations, the curved reflector can be replaced by a plane mirror.

Waviness of surfaces can be measured and simultaneously recorded on graph paper with another optical measuring device, recently developed in Switzerland. It consists substantially of an aluminum bar with a longitudinal slot serving as a guide for a telescope which

lightly contacts the work surface at two points. This telescope picks up light rays from two lenses at either end of the aluminum bar which rests on two Johansen blocks on the workpiece. Two hairlines seen in the telescope then are used as references for measuring the waviness when moving the telescope within the slot. By connecting the telescope spindle with a pen moving over graph paper attached to the aluminum bar, it is possible to obtain records of the waviness.

The accuracy of the device is 0.000030 inch in the center and 0.000060 inch at the ends of the aluminum bar.

Numerous other measuring instruments also are described in the same article, such as microscopes for measuring internal and external threads, profilometers, interference microscopes and others.

Tools for Watch Manufacturing Industries

The development in the manufacture of watches and other precision instruments has caused considerable improvements in measuring tools and testing equipment, according to L. Ebosa in *Microtecnic*. A depth micrometer is described and illustrated; it has a margin of error not greater than 0.000080 inch. The same instrument can also be used for measuring the exact radius of a curved surface such as lenses, eliminating the so-called "human error." In special cases the error can be reduced to 0.000020 inch.

In the same issue there also are articles on the accuracy obtained in turning watch parts and on high frequency heat-treatment of such parts.

Instrument and Measurement Conference

An International Conference was held in Stockholm, Sweden on the development of instruments for measuring dimensions, temperatures, gases and other quantities. Papers were presented by representatives from the U.S.A., England, Germany, Switzerland, Sweden, Norway, and Holland, acording to a report in No. 5, 1952 of the Swiss periodical *Microtecnic*. Among the papers of interest to tool engineers was a paper by R. Schulze (Germany) on the relation between micro- and macrohardness. The Vickers and Knoop hardness values which are constant in the macrohardness range increase with decreasing loads in the microhardness range for almost all materials. The reason is the incompleteness of the Vickers and Knoop formulas which con-

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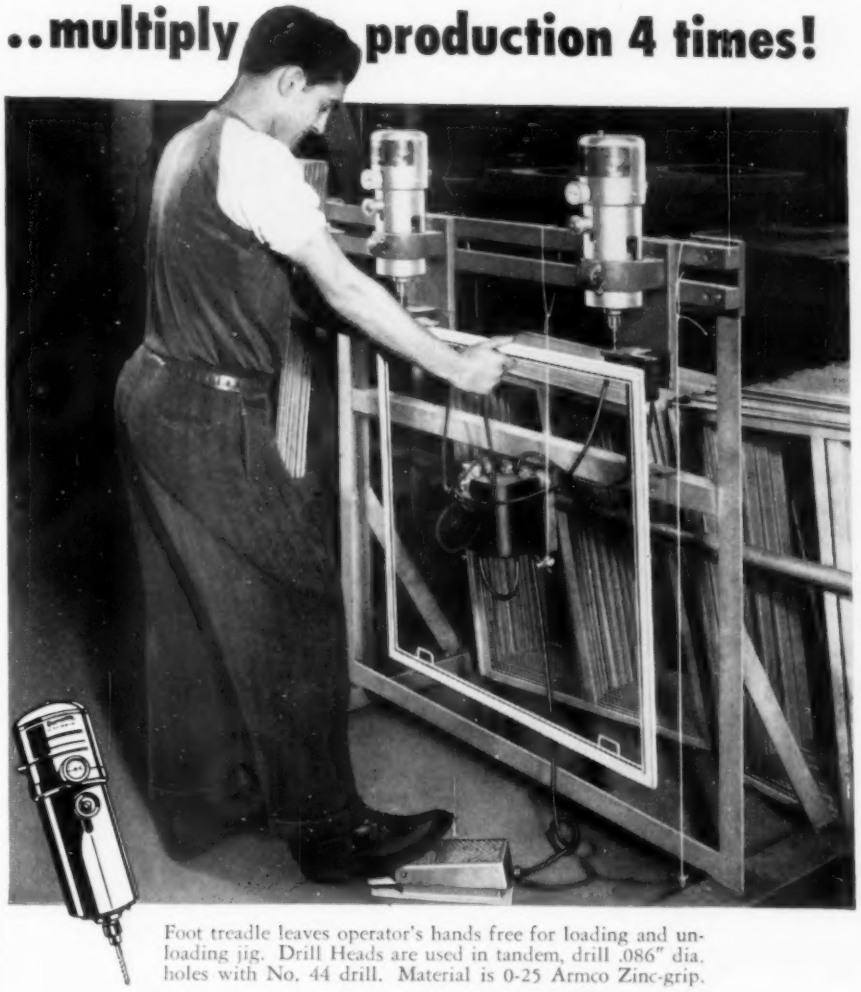

Foot treadle leaves operator's hands free for loading and unloading jig. Drill Heads are used in tandem, drill .086" dia. holes with No. 44 drill. Material is 0-25 Armco Zinc-grip.

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And the most amazing thing about this report is that it is not an isolated case. In fact, increased output and similar savings on costs of production, scrap loss, and reductions in down-time, are being effected in practically every instance where Dumore Automatic Drill Heads have been installed. As this manufacturer says, "They are a 'natural' for multiple drilling operations."

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sider plastic (that is permanent) deformation and disregard elastic (that is temporary) deformation. In the microhardness range—such as measured in chip formation and metal-cutting studies—it is necessary to add a factor to the value of the impression diagonal. The author outlines this in detail and also discusses a new hardness tester.

A. Soederholm of Stockholm Institute of Technology presented a paper on a new method for prestrain of the wire in strain-gages. This work was carried out at the Aeronautical School of the Institute and gives the possibility of applying smaller forces than usual.

Van Oort, Holland, discussed a method for measuring the dynamic-mechanical properties of plastic materials, particularly the determination of the modulus of elasticity, damping factors of vibration, etc. The Swiss development in instruments for measuring of torque, acceleration, vibration, pressures, forces and high rotary speeds was outlined by C. von Basel.

Metal-Cutting Conference

A metal-cutting conference was held in June 1952 at the Aachen Institute of Technology as reported in the December 1952 issue of *Werkstattstechnik und Maschinenbau.*

H. J. Wicster presented a paper on "Machinability and Microstructure," indicating that, for low and medium carbon contents, a ferrite-perlitic microstructure improves machinability while, in the case of a high carbon content, a spheroidized perlite microstructure improves machinability.

G. Weber reported on "The Effect of the Heat Treatment of the Workpiece on the Wear Land of Carbide Tools." According to his investigations it is not sufficient to judge tool life by the wear land on the tool flank; it is necessary to consider also the wear on the tool face, particularly when high-cutting speeds are used. H. Hucks discussed the relationship between temperature and tool life, and C. Ballhausen presented a report on "Systematic Classification of Carbides." Other speakers covered such topics as productivity of machine tools, bearings, guideways, electronics and their effect on tool engineering.

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The corporate name of the National Machine Tool Co. has been changed to Heinrich Tools Inc. according to a recent announcement made by John Gertenbach, secretary.

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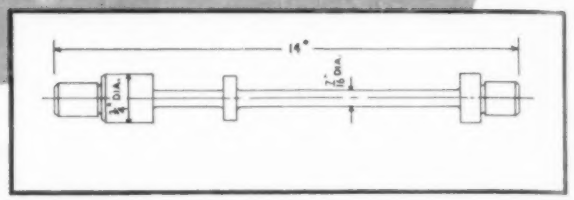

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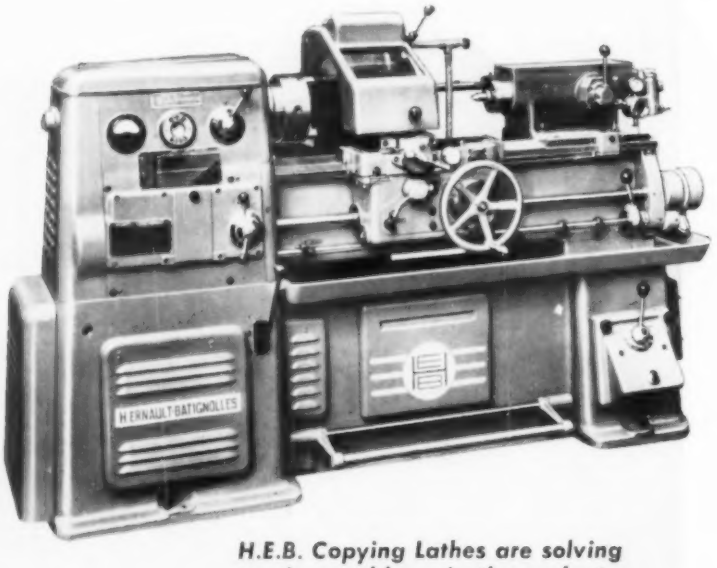

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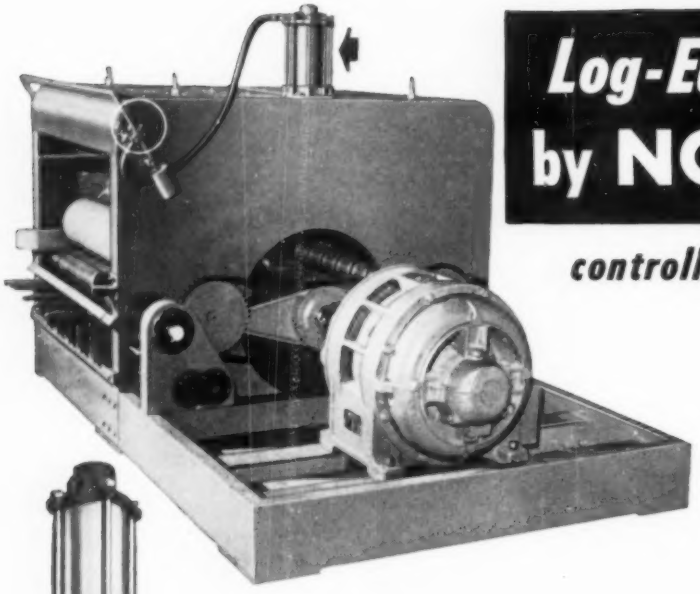

NOPAK Model "D" Air Cylinder for Right Angle Flat Base Mounting, Rod End.

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Refer to Sweet's File for Product Designers or write for Bulletin SW-1.

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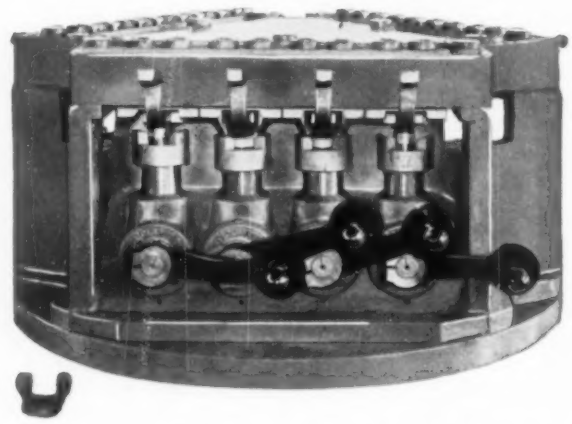

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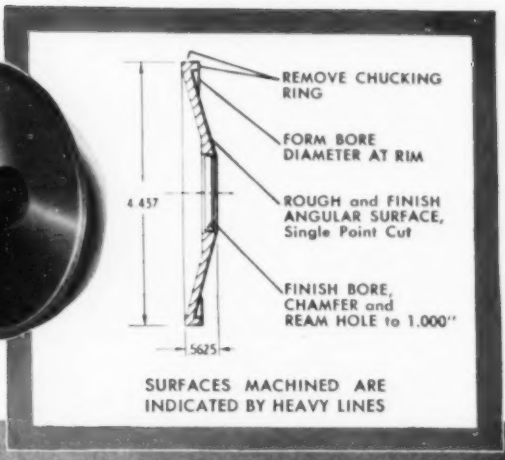
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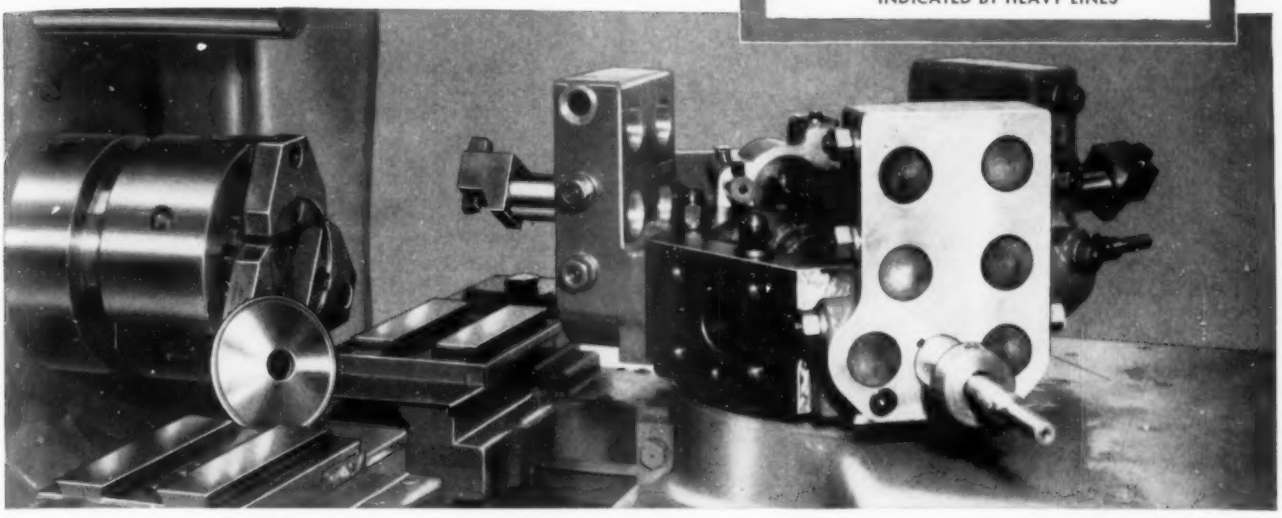

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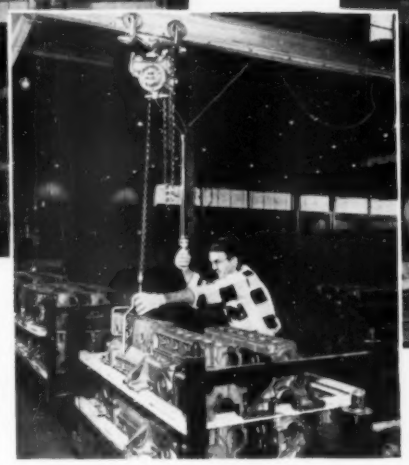

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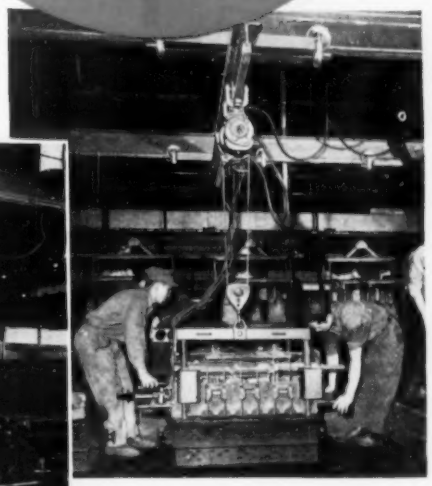

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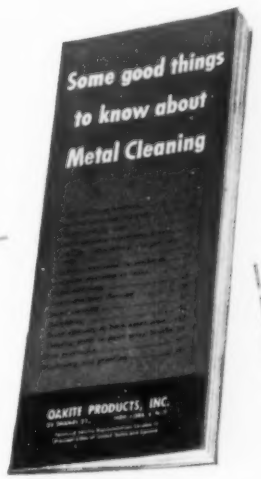

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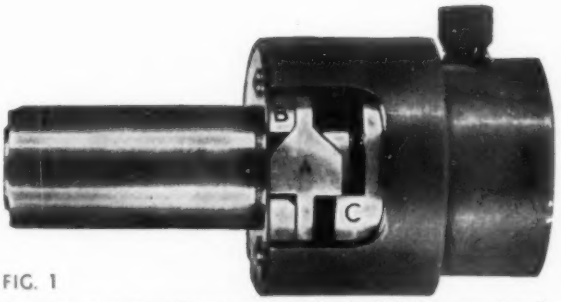


FIG. 1
Ready to start threading operation, clutch slightly engaged at C.

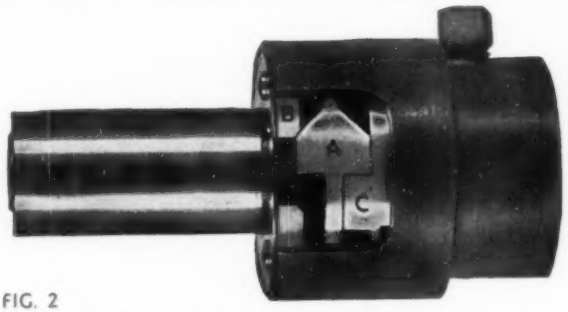


FIG. 2
Instantly engaged to full contact between A and C as soon as tap or die engages work.

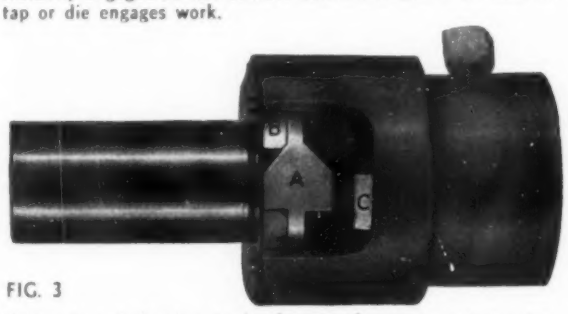


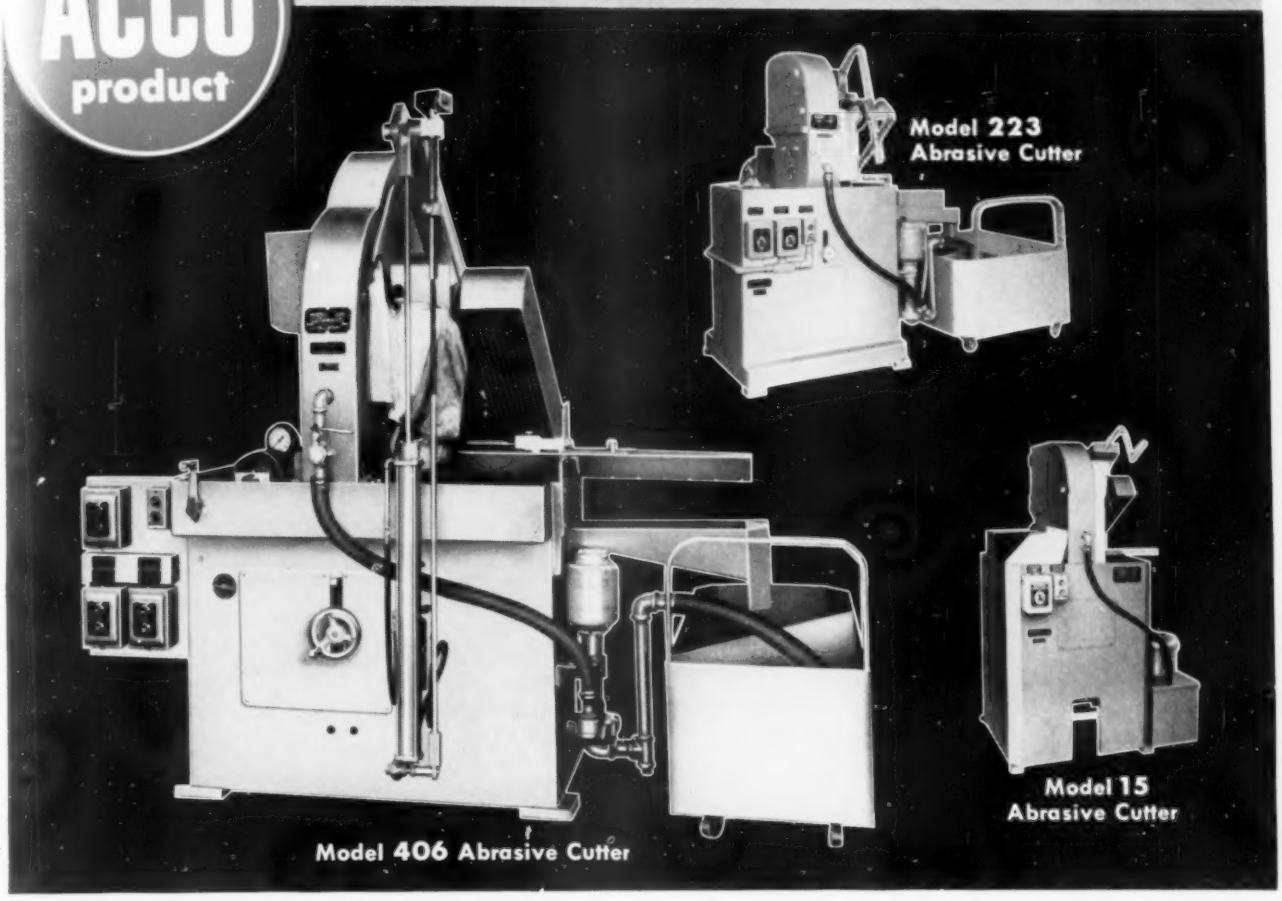
FIG. 3
Fully released showing ample clearance between contact points of clutch preventing reengagement or hammering of clutch points in case turret advances slightly after clutch releases.
By substituting a shorter clutch ring retaining nut this tool can be readily changed for cutting extra short threads.

R AND L TOOLS 1825 BRISTOL ST., PHILADELPHIA 40, PA.

Turning Tool, Universal Tool Post, Floating Drill Holder, Carbide and Roller Backrests, Revolving Stock Stop, Tap and Die Holder, Cut Off Blade Holder, Turret Backrest Holder, Releasing Acorn Die Holder, Knurling Tool and Recessing Tool.

an ACCO product

CAMPBELL Abrasive Cutters



Try the CAMPBELL Abrasive Cutting Method

• Comparison of cutting time using a CAMPBELL ABRASIVE CUTTER against ordinary means of cutting shows great savings.

CAMPBELL ABRASIVE CUTTERS are made in many styles and models, fully automatic and semi-automatic. Quality cuts are free from surface hardening, exceptionally smooth, and practically burr free. Close tolerances of cut-off lengths can be held, and in many cases eliminate or reduce subsequent operations.

Fully automatic machines cut solid steel up to 6″ diameter, any analysis, any hardness. Semi-automatic machines cut up to 8″ diameter or square. All CAMPBELL ABRASIVE CUTTERS are completely guarded and have many exclusive safety features.

CAMPBELL ABRASIVE CUTTERS pay for themselves quickly by doing better work *faster*. Let us know your requirements and we will make recommendations.

Write today for Bulletin DH-260 on Campbell Abrasive Cutting Method

ACCO

TRADE MARK

CAMPBELL MACHINE DIVISION
AMERICAN CHAIN & CABLE

945 Connecticut Ave., Bridgeport 2, Conn.

CAMPBELL
Abrasive Cutters and Nibblers

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-181

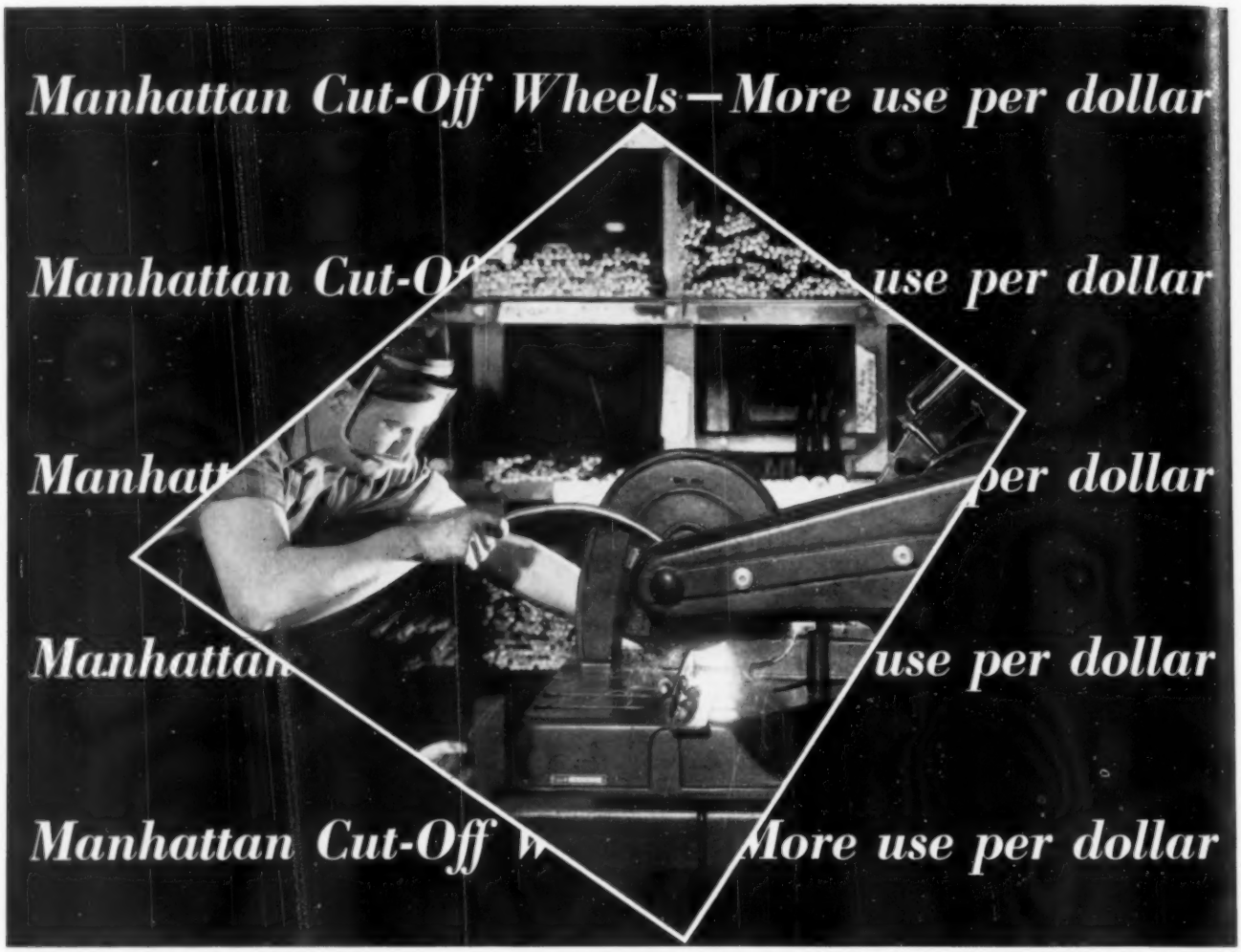

Manhattan Cut-Off Wheels—More use per dollar
Manhattan Cut-O use per dollar
Manhat per dollar
Manhattan use per dollar
Manhattan Cut-Off W More use per dollar

PHOTO COURTESY DELTA MANUFACTURING DIVISION

FASTER, CLEANER CUTTING . . . with Manhattan Cut-Off Wheels means savings in hours and dollars. And Manhattan Cut-Off Wheels are noted for their long life and free cutting on all types of metals. In factories where records are kept of the number of cuts per wheel, Manhattan wheels consistently show that they are doing a *better* job and giving MORE USE PER DOLLAR. Investigate for yourself the savings that are possible with Manhattan Cut-Off Wheels. When you specify "Manhattan", you are ordering a wheel that is designed for your specific job, which means that it is custom-tailored for efficiency and economy.

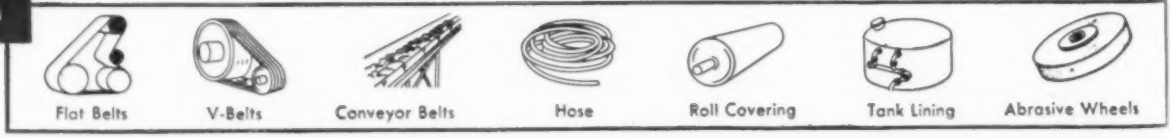
GRINDING WHEEL INSTITUTE MEMBER

WRITE TO ABRASIVE WHEEL DEPARTMENT

R/M

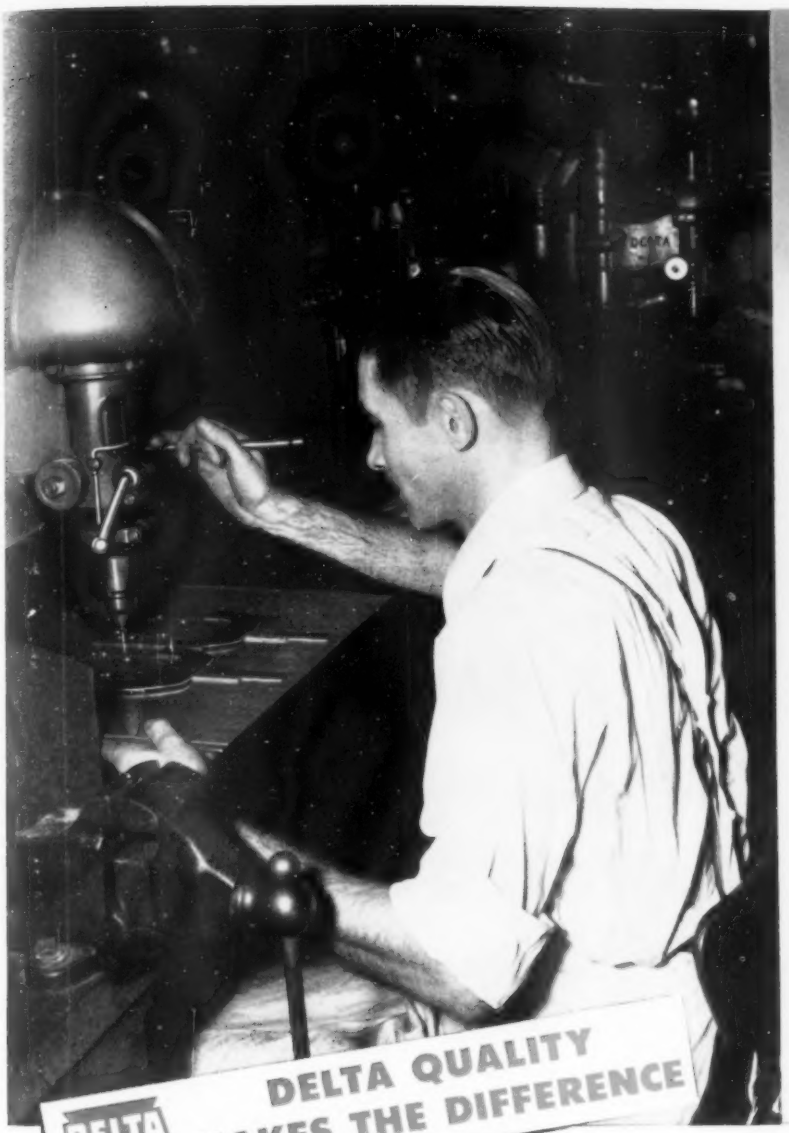
MANHATTAN RUBBER DIVISION — PASSAIC, NEW JERSEY

RAYBESTOS-MANHATTAN, INC.



Other R/M products include: Industrial Rubber • Fan Belts • Radiator Hose • Brake Linings • Brake Blocks • Clutch Facings Asbestos Textiles • Teflon Products • Packings • Sintered Metal Parts • Bowling Balls

MR 945



TOOL SHOP SHORT CUT—

A DELTA Drill Press on Every Work Bench Saves Time and Money for BINGHAMTON DIE & MACHINE CO.

"It's much cheaper to install an individual 14" Delta drill press on every diemaker's bench than to move men and machines," says Frank Bowie, owner of this thriving Binghamton, N.Y., shop.

No waiting, no running back and forth—a Delta drill press on every work bench increases Binghamton Die & Machine Co. profits.

Making dies for big shoe factories is his main business, and on most jobs more than half the operations are done on a Delta drill press.

"Accuracy is absolutely essential," says Mr. Bowie, "and we've had remarkable service from our Delta drill presses—for 16 to 18 years, in some cases. At times we use them as arbor presses, and still they stay accurate. They're not babied, either—used night and day in rush periods. Maintenance cost is negligible—no more than $20 per year on all our Delta equipment."

In addition to 18 Delta 14" drill presses, the company has a 17" drill press, three Delta grinders, a 14" bandsaw and a disc grinder.

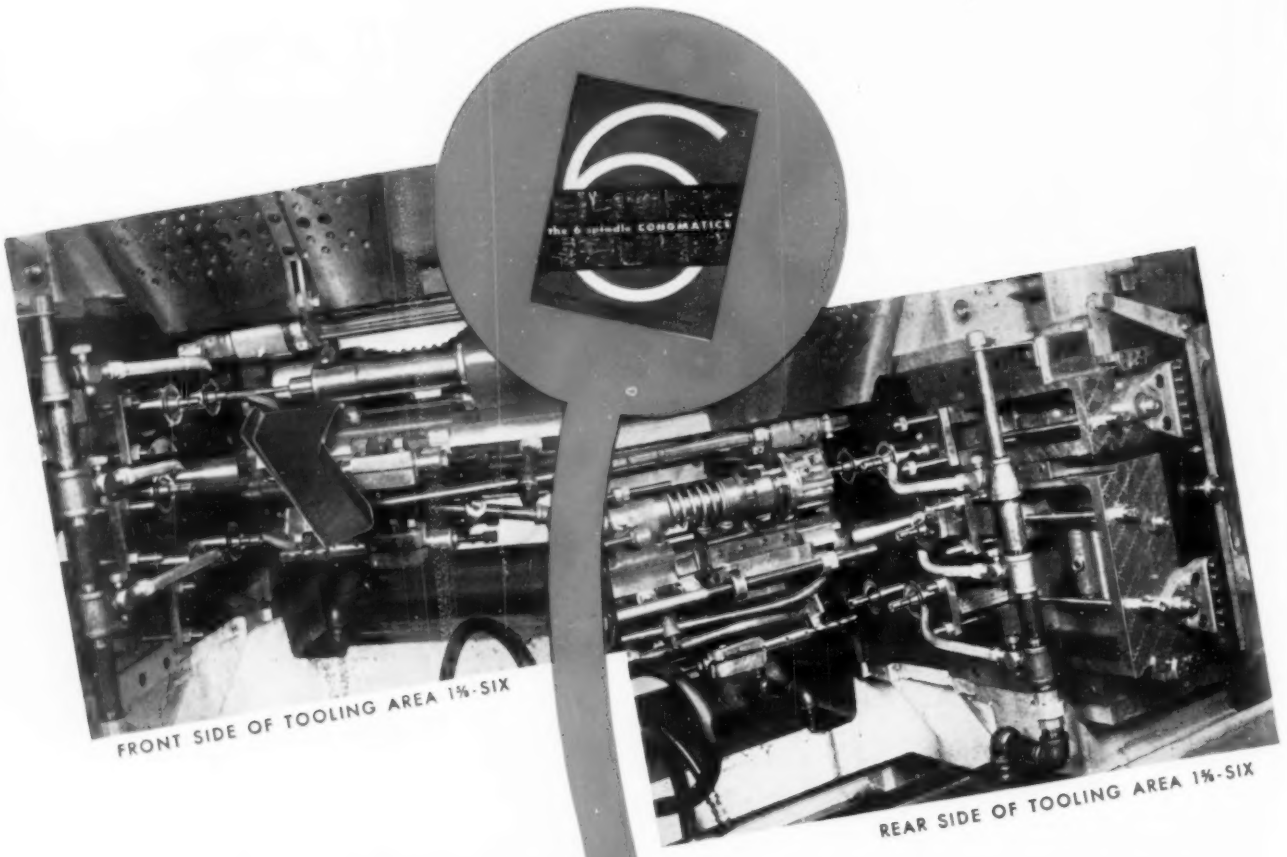
You, too, can save money with low-cost, high accuracy Delta tools. It costs you so little to have Delta tools throughout your shop—they're ready to use without waiting, eliminate set-up for special jobs, and are easy to relocate at any time.

Do you have up-to-date Delta literature? Send for Catalog AB-52; and call the Delta dealer—listed in the Classified Telephone Directory under "Tools." Write Delta Power Tool Division, Rockwell Manufacturing Company, 620D N. Lexington Ave., Pittsburgh 8, Pa.

Delta drill presses are available in floor and bench models.

DELTA QUALITY POWER TOOLS

Another Product of **Rockwell**



FRONT SIDE OF TOOLING AREA 1⅝-SIX

REAR SIDE OF TOOLING AREA 1⅝-SIX

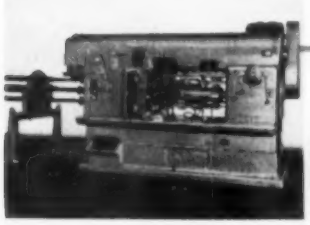
THE IMPORTANT REQUIREMENT

All brands of multiple spindle bar automatics offer value or they would not be on the market. If it were possible to engineer and incorporate the superior qualities of all into one machine, certain features would still be considered more important than others in accordance with the individual buyer's requirements.

But there is one essential quality required of all brands – regardless of the job. It is *dependable, low cost performance!* CONOMATIC users know well its benefits. But you don't have to be a user to know about this feature, or any other feature, of the CONOMATIC. Just write, wire, or phone for the information. There is no obligation.

Cross drilling without costly spindle stopping is one of many CONOMATIC innovations which make use of the machine's unexcelled accommodation to tools and work. But any such facility that saves secondary handling is valuable only because of the more important "built in" qualities that keep the machine running.

A Comparison of ALL Automatics is in favor of Cone



Conomatic

CONE AUTOMATIC MACHINE COMPANY, INC. WINDSOR, VT., U.S.A.

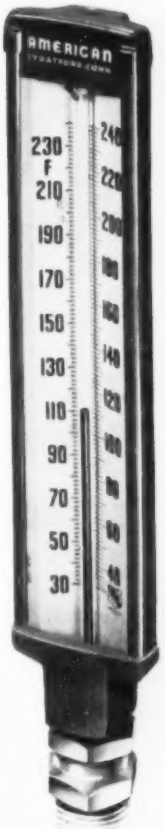
Bronze Extrusion makes a stronger case for this industrial glass thermometer

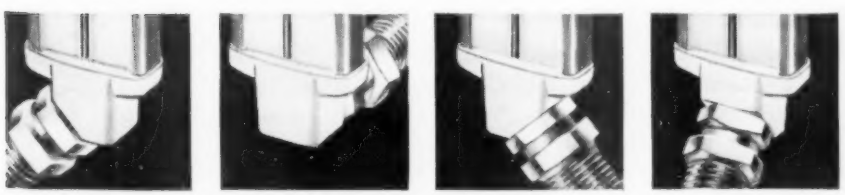
The case for this "American" Industrial Glass Thermometer made by Manning, Maxwell & Moore, Incorporated, Stratford, Conn., used to be a steel stamping. Now it's made of ANACONDA Extruded Bronze.

Why the change? Because this extruded bronze shape makes a far stronger and more rigid case; it's easier to produce; it simplifies assembly—and adds additional quality to an already high-quality product. So accurate are these bronze extrusions that neither straightening nor machining is needed for assembly. And assembly time itself is cut.

For the base, an ANACONDA Brass Die Pressed Forging is joined to the case by brazing to provide greater joint strength. By machining the appropriate face of a single-style base forging, a stem connection can be provided at any angle.

ANACONDA Brass and Bronze have long been making a stronger "case" for products—by simplifying production; by the higher quality that is always associated with products made of brass or bronze; by increasing sales appeal. We urge you to consider the advantages of these metals for your manufacturing processes and your products. For information, write to The American Brass Company, Waterbury 20, Connecticut. In Canada: Anaconda American Brass Ltd., New Toronto, Ontario.





Base forging can be machined to provide stem connection at any angle and direction.

Extruded case and forged base for this 9-in. "American" Thermometer are joined in perfect alignment by brazing. No machining or straightening is required.

ANACONDA® —the name to remember in COPPER—BRASS—BRONZE

OSBORN

Brush C deburrs bottom of slot

Push-button brushing deburrs 1400 parts per hour

The Problem here was to remove feather burrs from a machined slot in aluminum ammunition components . . . *fast.* By a hand method, *output was only 360 per hour* and results were not uniform.

With the help of the **O**sborn **B**rushing **A**nalyst, the company built the rotating fixture shown above, equipped with three Osborn Master Wheel brushes. Parts are placed on pins on clockwise-rotating table. Brush A, rotating clockwise, deburrs the corner of one side of slot. Brush B, rotating counterclockwise, deburrs the other side corner. Brush C deburrs the bottom corner. Slots come clean and smooth . . . *at a rate of 1400 per hour!*

Find out how power brushing can improve *your* product deburring, cleaning and finishing! Call the **OBA** or write *The Osborn Manufacturing Company, Dept. K-2, 5401 Hamilton Avenue, Cleveland 14, Ohio.*

Brushes A and B deburr side corners. Brushes rotate at 3450 rpm.

Osborn Brushes

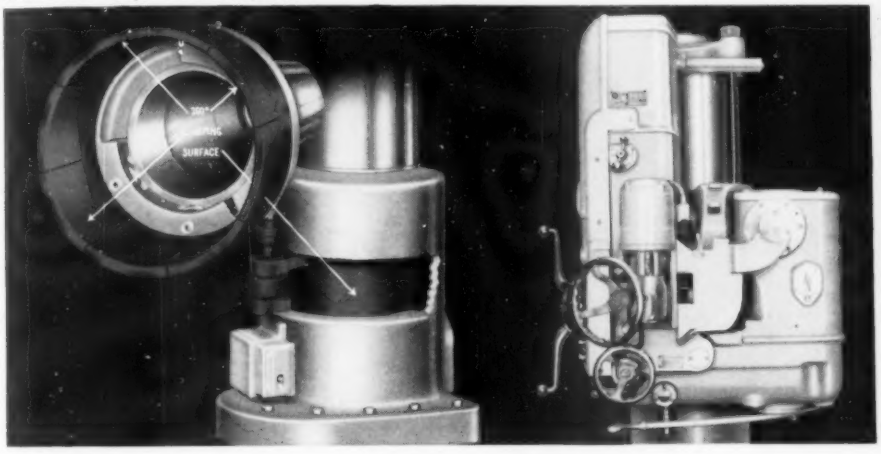
OSBORN POWER, MAINTENANCE AND PAINT BRUSHES AND FOUNDRY MOLDING MACHINES

Only ONE can be called the Finest: Carlton

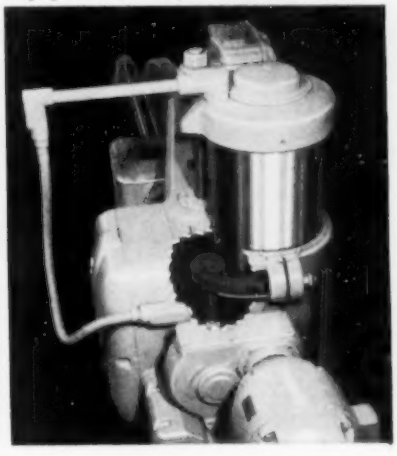
...here's another good reason why:

3-unit power clamping

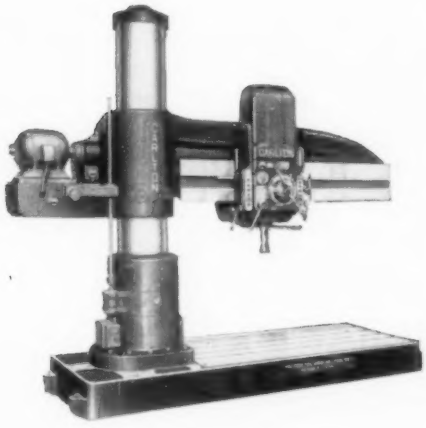
COLUMN AND HEAD CLAMP *coupled together so that one pushbutton operates both units for clamp and unclamp. Column clamp gives 20% more rigidity than previous designs, assures better finished surfaces.*



ARM CLAMP *and unclamp automatically controlled from the raise, lower and stop pushbutton of the elevator unit.*



Easier, Faster, More Productive, Cheaper to Operate



Positive and powerful, this exclusive 3-unit power clamping puts precision into the radial drill.

Pushbutton controlled, it's easy and fast to clamp and unclamp, resulting in more production

Electric power is used only to clamp and unclamp; mechanical power holds units in position while drilling. Results in most economical operation.

Carlton customers—hundreds of them—bought their Carlton radial drills solely on the strength of this efficient clamping. The many other advantages they enjoy—including the exclusive pushbutton control, low hung drive, modern lubrication—explain in part why Carlton is the No. 1 radial choice. But you'll want to know "the hole story"—prices, deliveries—so write or wire us today.

THE CARLTON MACHINE TOOL CO., CINCINNATI 25, OHIO.

This die is different
because it is made of aluminum (Alcoa Aluminum Tool & Jig Plate). It is easier to handle, faster to machine and costs less to make than a steel one.
Alcoa Tool & Jig Plate is also used to make fixtures, low-pressure rubber and plastic molding dies and dies for forming aluminum sheet.
Alcoa casts Tool & Jig Plate in thicknesses from ¼" to 4". It is normalized and available from stock in widths up to 48" x 96", machined both sides.
Aluminum Company of America, 1952-D
Alcoa Building, Pittsburgh 19, Pa.
ALCOA ALUMINUM TOOL & JIG PLATE
Alcoa Aluminum
ALUMINUM COMPANY OF AMERICA

a critical ORDNANCE job solved with . . .

die
BY MOORE SPECIAL TOOL CO.

die set
BY **PRODUCTO**

Millions of small ordnance fuse component springs stamped exactly right. Tolerance between punches and dies is maintained thru 18 stations at .0005" . . . only the top quality of Producto Die Sets makes such accuracy possible.

OPERATIONS: Piercing, forming, blanking.
SIZE OF PIECE: 1¼" long, ⅛" wide.
MATERIAL: .012 spring steel.
PIECES PER GRIND: 100,000.
PRODUCTION: 9,600 pieces per hour.

For definite dollar savings, maintained accuracy and highest production, specify "PRODUCTO" . . . approved by the country's leading manufacturers.

THE PRODUCTO MACHINE COMPANY
930 Housatonic Ave., Bridgeport 1, Connecticut

For Precision Die Sets *Fast* Call . . .

PRODUCTO

ALSO MAKERS OF TOOL AND DIEMAKERS ACCESSORIES, VISES, MACHINERY

2PD52

CARMET

can solve *YOUR* *Wear-Resistance* problem

● WHAT JOBS HAVE YOU FOR CARMET CARBIDES TO DO?

For maximum wear, save with Carmet—preformed to practically any shape or size! *Examples:* entire blanking die parts; inserts for drawing, heading, extruding and blanking dies; gauge and wear parts, pins, bushings, etc. *Supplied Preformed* —with minimum grind stock allowed, or precision ground and ready for use. Let us work with you . . . send us your drawings and specifications for quotations. ● *Allegheny Ludlum Steel Corporation, Carbide Alloys Division, Wanda and Jarvis Avenues, Detroit 20, Mich.*

For complete MODERN Tooling, call

Allegheny Ludlum

AL
FINE TOOL STEELS
SINCE 1854

LET HARD • LONG WEARING • FASTER CUTTING

Tungsten Carbide

DO YOUR DRILLING TOO!

STC

We Have the Type of Drill You Need — And the Engineering experience to help you to use it properly. Ask for Supplement No. 4 on Carbide Drills.

QUALITY CARBIDE TOOLS

Super TOOL COMPANY

21650 Hoover Rd., Detroit 13, Michigan • 5210 San Fernando Rd., Glendale 3, California.

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-191

Announcing . . .

FRONT VIEW

REAR VIEW

The new 48-inch ROTAB

with motor-driven table for fast and easy positioning of work

Now a giant ROTAB!—to give you an extra sized table (48-inch) with benefit of motor-drive to position work fast and easily. The table, with 8 tee slots for clamping work, can be rotated by push of button, and locked to any degree to precision accuracy within 2 min. by vernier graduations. Can also be set from vertical to 30° below horizontal the opposite way.

● The 36-inch model also available with motor drive. Smaller models—12" and 24"—are set manually.

Send to Dept. G for complete catalog

MACHINE PRODUCTS CORPORATION
6771 E. McNICHOLS RD. • DETROIT 12, MICHIGAN

USE READER SERVICE CARD; INDICATE A-4-192-1

There's a Walker Magnetic Chuck for Every Known Application . . .

For sixty years, Walker has specialized in the designing and production of magnetic holding devices. Today, Walker produces a complete line of magnetic chucks and designs special chucks to meet unusual holding problems.

●

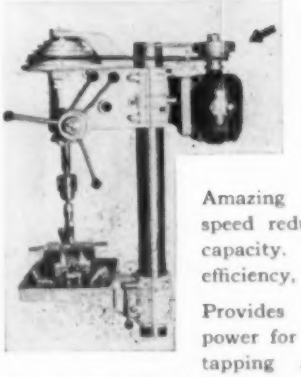
Standard Electro and Permanent Magnetic Chucks . . . Vacuum Chucks . . . Special Applications for various holding problems . . . Demagnetizers . . . Magnetic clutches.

Original Designers and Builders of Magnetic Chucks

O. S. WALKER CO. Inc.
WORCESTER 6, MASSACHUSETTS

USE READER SERVICE CARD; INDICATE A-4-192-3

New **"PULL-GEAR" SPEED-REDUCING PULLEY Increases Drill Press Capacity**



Amazing new internally geared speed reducer doubles drill press capacity. Greater power, greater efficiency, greater productivity.

Provides the correct speed and power for larger drilling, reaming, tapping and boring on light presses. Easily installed in five minutes. Adaptable to all type machines. Spindle speed range approx. 45 to 2000 RPM. Write for literature.

Made in 3 Motor Shaft Sizes 1/2" - 5/8" - 3/4"

Some Territories Open to Jobbers

THE PULL-GEAR CO.
4118 E. 8-Mile Rd., Detroit 34, Mich.

WRITE FOR LITERATURE

USE READER SERVICE CARD; INDICATE A-4-192-2

What **TO DO TO SAVE SET-UP TIME**

Much time can be saved in making set-ups for tapping and reaming by simply using a Ziegler Floating Tool Holder instead of an ordinary tool holder. Here's why!

With ordinary tool holders the work must be aligned very accurately with the spindle. This requires considerable time. But with the Ziegler Holder it is sufficient if the work is aligned within 1/32" of center on the radius (1/16" of center on the diameter). The Ziegler Holder automatically compensates for the difference.

Thousands have proved this to their own satisfaction over a long period of years. Why not try it and see!

W. M. ZIEGLER TOOL COMPANY
13574 AUBURN DETROIT 23, MICH.

Ziegler ROLLER DRIVE **FLOATING HOLDER** *for* **Taps** *and* **Reamers . . .**

WRITE FOR CATALOG

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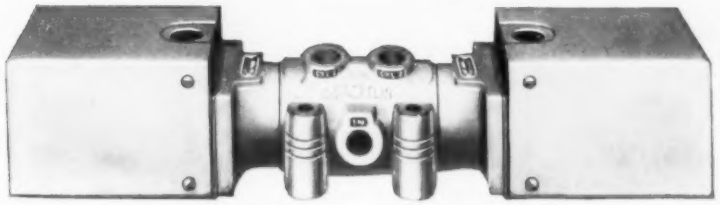
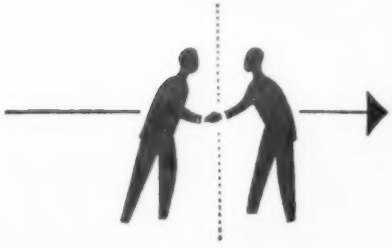
Electricity and Oil

ARE SWELL PARTNERS

Rivett Series 5550 Double Solenoid Operated Spring Centered Valve.



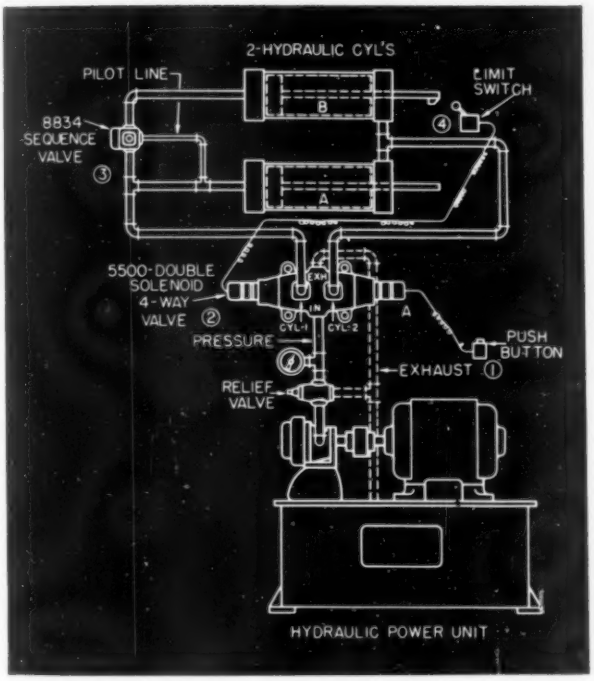


when you use a RIVETT SOLENOID HYDRAULIC VALVE!

You can be sure of positive control of hydraulic power with the new Rivett Solenoid Hydraulic Valves.

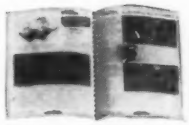
Designed with a hydraulically balanced piston, these valves are available in Double Solenoid with Standard Action, Single Solenoid with Spring Return, and Double Solenoid with Spring Centered. Solenoid Pilot Valves are also offered in each of the above three types of action. Five standard piston designs are offered to meet the requirements of any hydraulic circuit; other arrangements of spool porting may be had.

Features that make these valves outstanding in performance include balanced piston construction; a one piece, hardened, ground and lapped plunger; "O" ring seals; solenoid covers; symmetrical design.



SEMI-AUTOMATIC ELECTRIC CONTROL WITH SEQUENCE FEATURE

Cycle is started by momentarily depressing push button 1 which energizes solenoid coil of Model 5500 4-way control valve 2. Cylinder A extends; at completion of outward stroke, pressure will increase in cylinder A supply lines causing sufficient pilot pressure to open sequence valve 3, permitting oil to flow to cylinder B, and cylinder B extending. Limit switch 4 is momentarily actuated by piston rod of cylinder B, energizing opposite solenoid coil of 4-way valve. Oil flow to cylinders is reversed and cylinders A and B retract. Where piston velocities and inertia of connected loads are high, cushion cylinders are recommended. If external stops are provided, cushioning is not required.



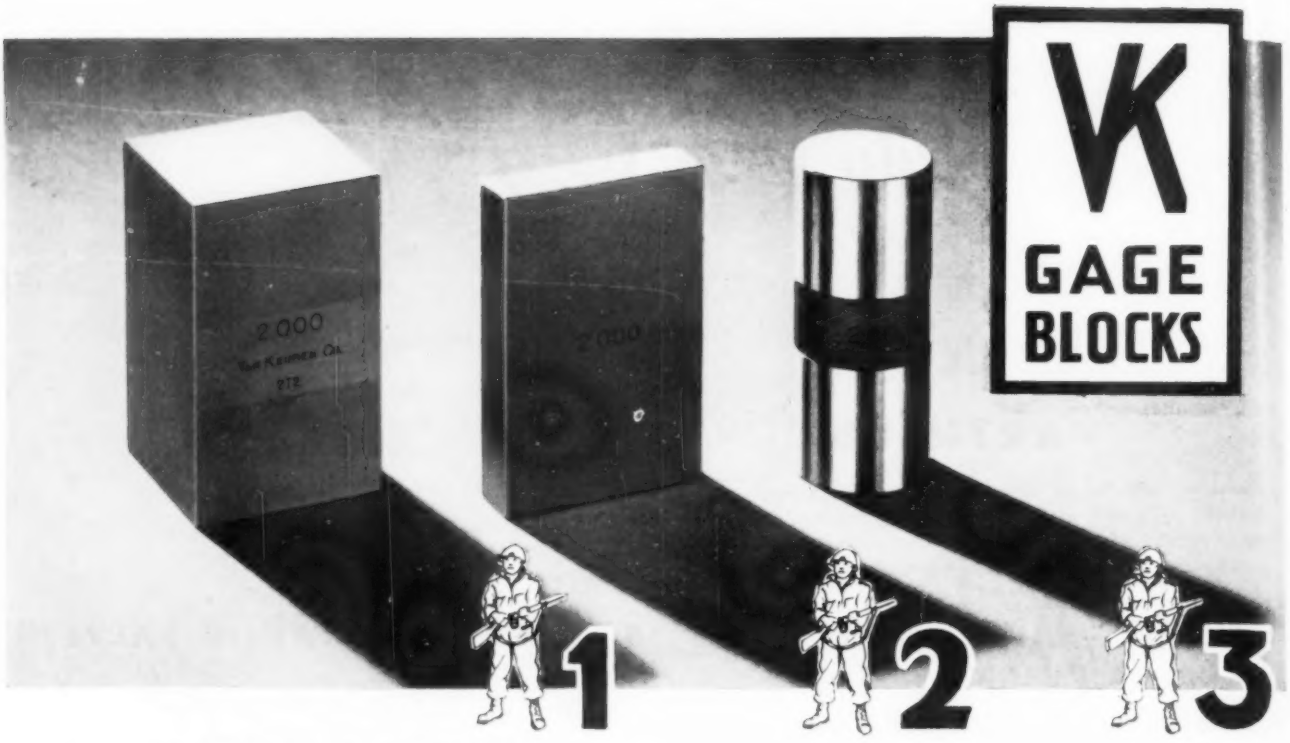
Write for Catalog Section No. 203 illustrating and describing all Rivett Hydraulic Valves.

RIVETT LATHE & GRINDER Inc.
DEPT. TE4 • BRIGHTON 35, BOSTON, MASS.

WHEN YOU APPLY HYDRAULIC OR AIR POWER *Plan with* **RIVETT**

AIR AND HYDRAULIC VALVES AND CYLINDERS, HYDRAULIC POWER UNITS

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-193



SOLDIERS THREE . . . *defending production accuracy*

To meet the requirements of the current defense effort in meeting closest limits of accuracy and protecting production, Van Keuren is currently furnishing three types of gage blocks:

1 SOLID SQUARE MASTER BLOCKS

2 RECTANGULAR REFERENCE GAGES

3 MICROGAGES

Shipment on complete sets of any of these three types can be made within 60 days from receipt of order.

VK Solid Square Master Blocks are accurate to .000004″ per inch of length and are designed for laboratory use or to standardize all shop dimensions. Large wearing surface; perfect parallelism. Available in 85- and 41-block sets and guaranteed unconditionally for 5 years not to exceed .0001″ in wear.

VK Rectangular Reference Gages are guaranteed accurate to .000008″ per inch of length and are designed for the inspection department or precision set up work. They are available in 81-block and 33-block sets. Individual blocks from either of these sets can also be furnished. Certificate of size is also furnished with each set.

VK Microgages are accurate to plus .000012″, minus .000008″ per inch of length and are designed as working gages for shop use . . . to put accuracy at the machine. Wearing surface is 40% greater than that of rectangular gage blocks, hence their long-wearing quality. Available in several set combinations.

Van Keuren Gage Blocks are fully described in Catalog and Handbook No. 35, yours for the asking by writing: The Van Keuren Co., 174 Waltham St., Watertown, Mass.

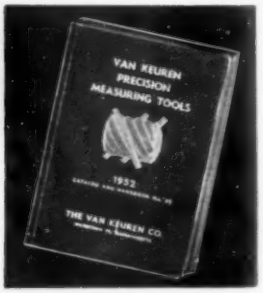
VK

34th YEAR

THE *Van Keuren* CO.,

174 WALTHAM STREET, WATERTOWN, MASS.

Light Wave Equipment • Light Wave Micrometers • Gage Blocks • Taper Insert Plug Gages • Wire Type Plug Gages • Measuring Wires • Thread Measuring Wires • Gear Measuring System • Shop Triangles • Carboloy Cemented Carbide Plug Gages • Carboloy Cemented Carbide Measuring Wires



Your "Hole" Future

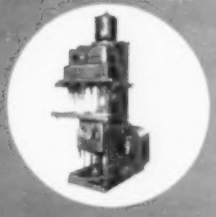
IS ASSURED WITH NATCO EQUIPMENT

ENGINEERED FOR QUALITY AND QUANTITY PRODUCTION

ADJUSTABLE SPINDLE MULTI-DRILLER AND TAPPER

MEDIUM SIZED VERTICAL DRILLER AND TAPPER

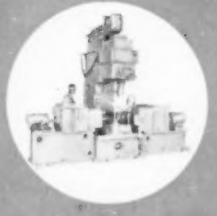
HIGH-SPEED MULTI-DRILLER OR TAPPERS



A-33 LIGHT SENSITIVE MULTI-DRILLER OR TAPPERS

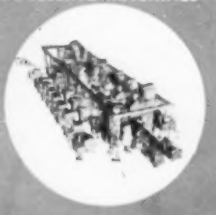
2-WAY BOREFACE FOR BORING, TURNING AND FACING

3-WAY HOLETAPPER WITH INDIVIDUAL LEAD SCREWS

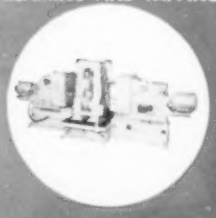


HOLESTEEL 2-WAY FLOOR TYPE FOR DRILLING AND TAPPING

HOLEWAY AUTOMATIC PROCESSING MACHINES



2-WAY HOLEUNIT FOR DRILLING, BORING, REAMING AND TAPPING



STATION TYPE MACHINES

Here are a few representative machines from the complete NATCO line . . . including a wide range from small, fast, light sensitive multi-drillers and tappers to large automatic processing machines . . . from single spindle to an unlimited number of spindles . . . from 1/16 inch drill to 14 inch or larger bore. Materials worked include iron, steel, bronze, aluminum, plastic and wood. Call a NATCO Field Engineer.

Call a Natco Field Engineer

To help you solve your problems in Drilling, Tapping, Boring & Facing.

NATCO

NATIONAL AUTOMATIC TOOL COMPANY, INC., Richmond, Indiana

Branch Offices | *1809 Engineering Bldg., CHICAGO • 409 New Center Bldg., DETROIT*
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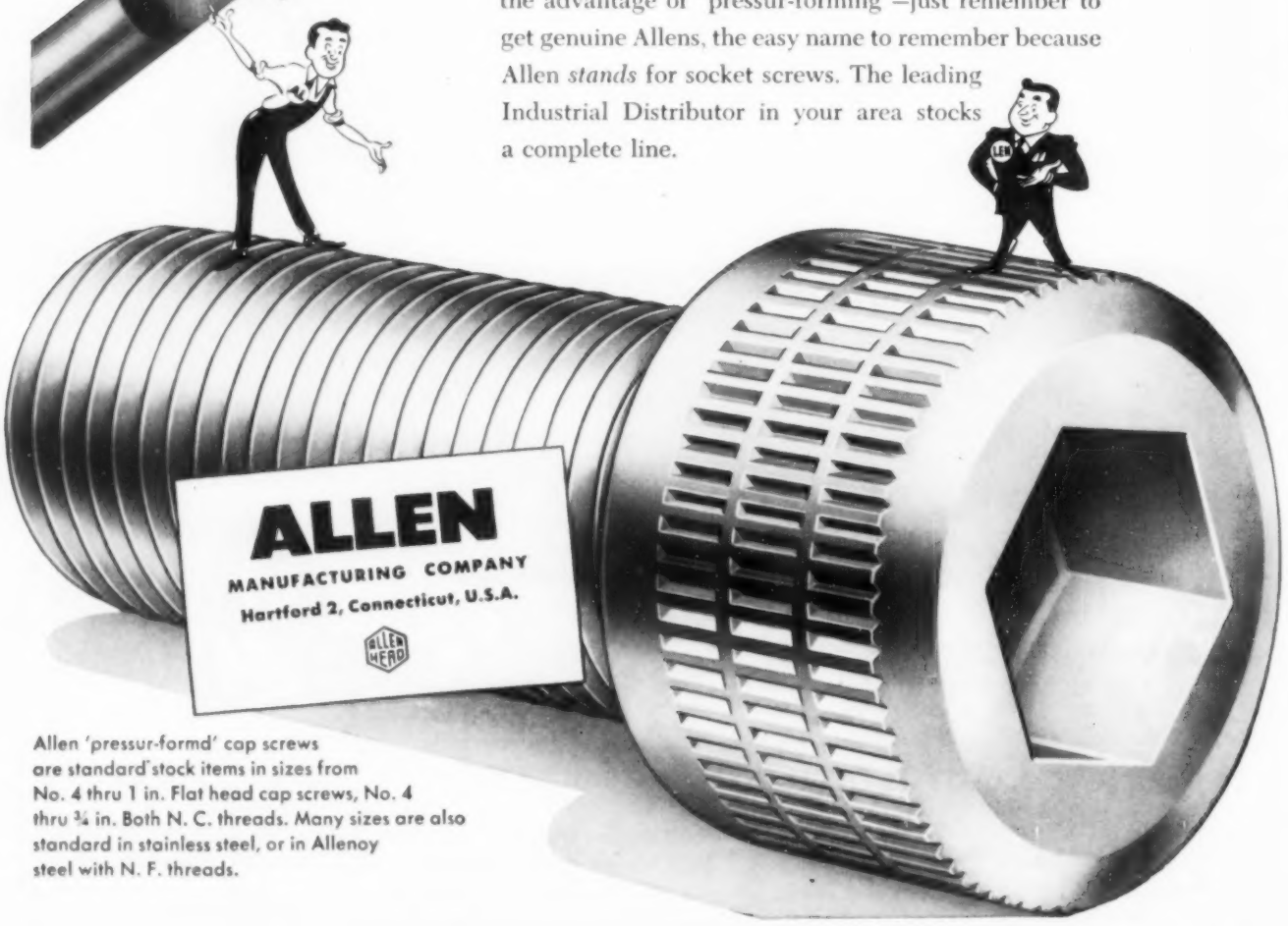
Pressur-Forming

ASSURES A BETTER FIT, GREATER STRENGTH, LONGER LIFE

ALLEN'S specialized and perfected method of cold forging Allenoy steel produces the tremendous strength, fatigue resistance and precision that made Allen the *Number One* name in socket screws. Full "pressur-forming" preserves the tough Allenoy fibers continuous, uncut and concentrated where strength is needed most . . . conforming to the contours of screw head, socket and threads.

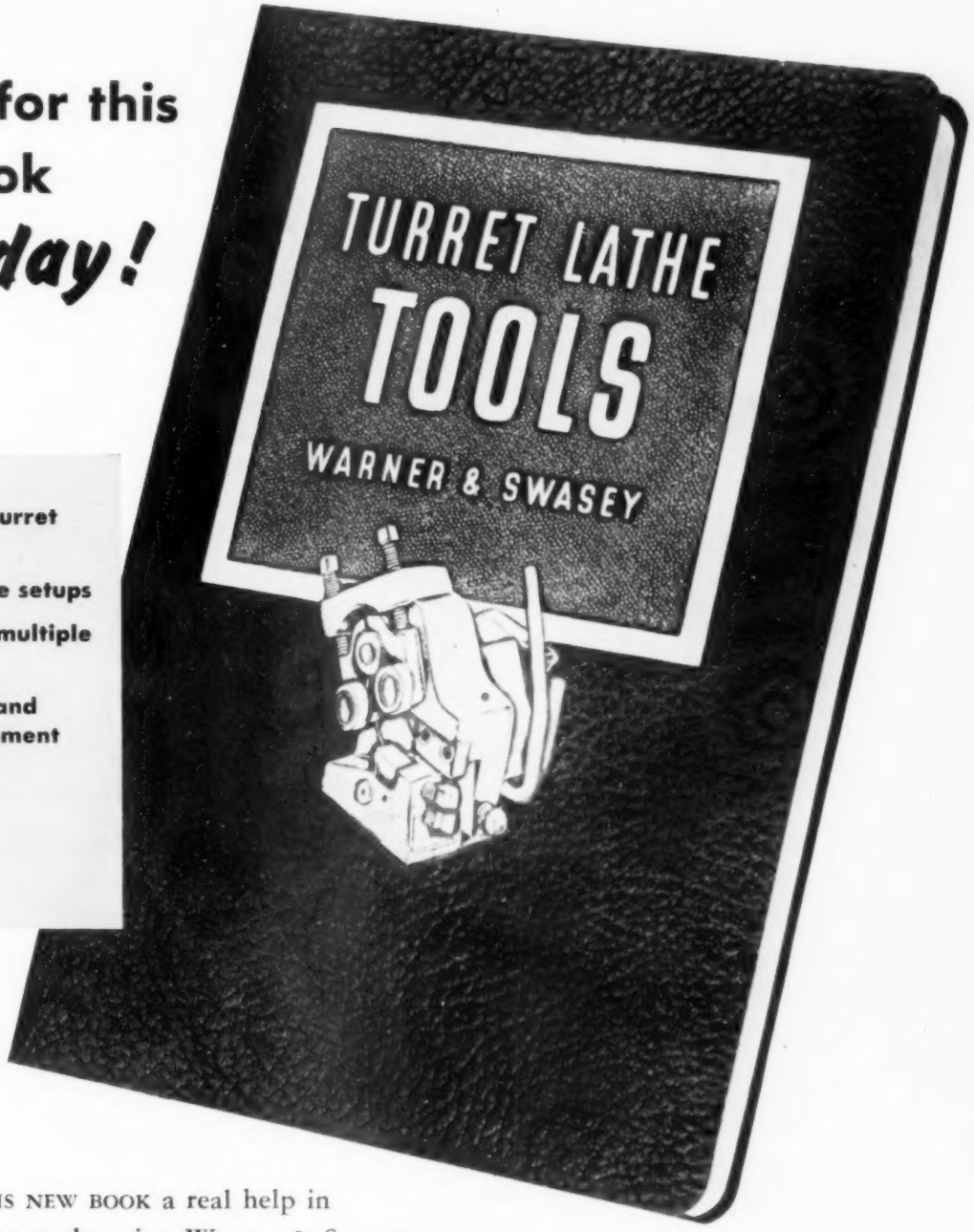
ALLEN PRESSUR-FORMING pays off in precision screws that you can count on to speed assembly, stand up better under continued hard usage. To be sure you get the advantage of "pressur-forming"—just remember to get genuine Allens, the easy name to remember because Allen *stands* for socket screws. The leading Industrial Distributor in your area stocks a complete line.



Allen 'pressur-formd' cap screws are standard stock items in sizes from No. 4 thru 1 in. Flat head cap screws, No. 4 thru ¾ in. Both N. C. threads. Many sizes are also standard in stainless steel, or in Allenoy steel with N. F. threads.

197 PAGES OF PRACTICAL INFORMATION

Send for this free book *today!*



- How to select turret lathe tools
- How to improve setups
- Combined and multiple cuts
- Universal bar and chucking equipment
- Special tools
- Data section
- Repair parts

YOU'LL FIND THIS NEW BOOK a real help in selecting and properly using Warner & Swasey turret lathe tools. It clearly and simply explains ways you can use modern tools to take full advantage of the increased speed and power of today's turret lathes. It's a book you won't want to be without —so send for your copy today!

WARNER & SWASEY *Cleveland* PRECISION MACHINERY SINCE 1880

WARNER & SWASEY COMPANY T-4-53
Department 320, Cleveland 3, Ohio

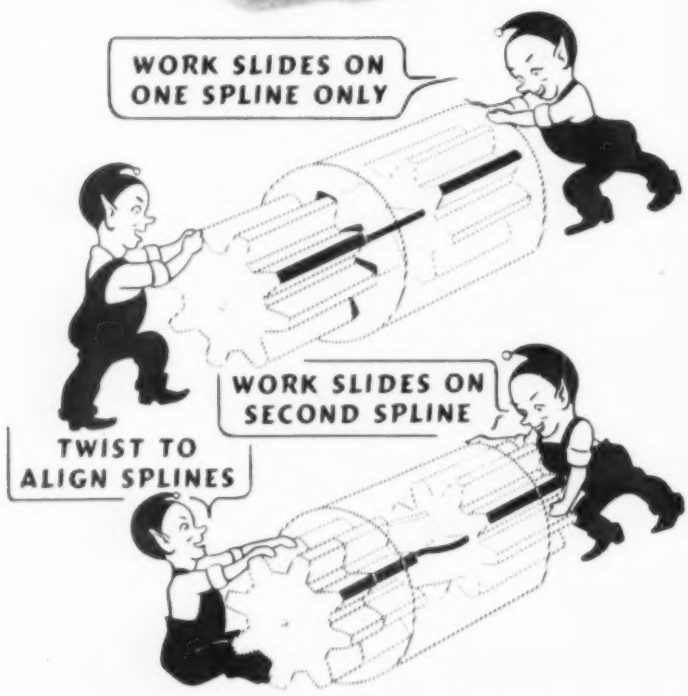
Please send me my free copy of "Turret Lathe Tools" today!

*Name*_____
*Company*_____
*Position*_____
*Address*_____
*City*_____
*Zone*____ *State*_____

YOU CAN PRODUCE IT BETTER, FASTER, FOR LESS WITH WARNER & SWASEY MACHINE TOOLS, TEXTILE MACHINERY, CONSTRUCTION MACHINERY

A NEW TWIST IN ARBORS

The Woodworth TWIST LOK *principle for splines*



The "Twist-Lok" arbor utilizes the inherent strength of tough, durable spring steel. There are no moving parts to wear. The Twist-Lok principle insures —

Accuracy you can trust

In a relaxed state, two spline surfaces are finished machined out-of-alignment. A part placed on the arbor goes on the first locating surface easily. With a twisting motion (wrench or air-operated) the reeds are "wound" permitting the spline surfaces to align, and allowing the part to be loaded. The twisting action is released and the part is chucked by the unwinding of the reeds.

One chucking surface is firmly against one wall of the part spline, the other chucking surface is firmly against the opposite wall of the part spline.

Your spline part is chucked securely and on center within a fraction of the concentricity tolerance.

The "Twist-Lok" arbor is additional proof that Woodworth Chucking Specialists have the answer to your chucking problem.

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PRECISION GAGES · DIAPHRAGM CHUCKS AND ARBORS · CONE-LOK JIGS

for better tool and die steels

LATROBE . . . the one source that furnishes tool steel free of carbide segregation - whether you buy on mill order or from warehouse stocks . . . the only producer to offer disc inspection service to all tool steel users as a guarantee of the top quality you get on every order . . . the supplier who uses ultrasonic Reflectoscope inspection to assure you of internal soundness in the tool steel you purchase.

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Sole Producers of "DESEGATIZED"® Steels

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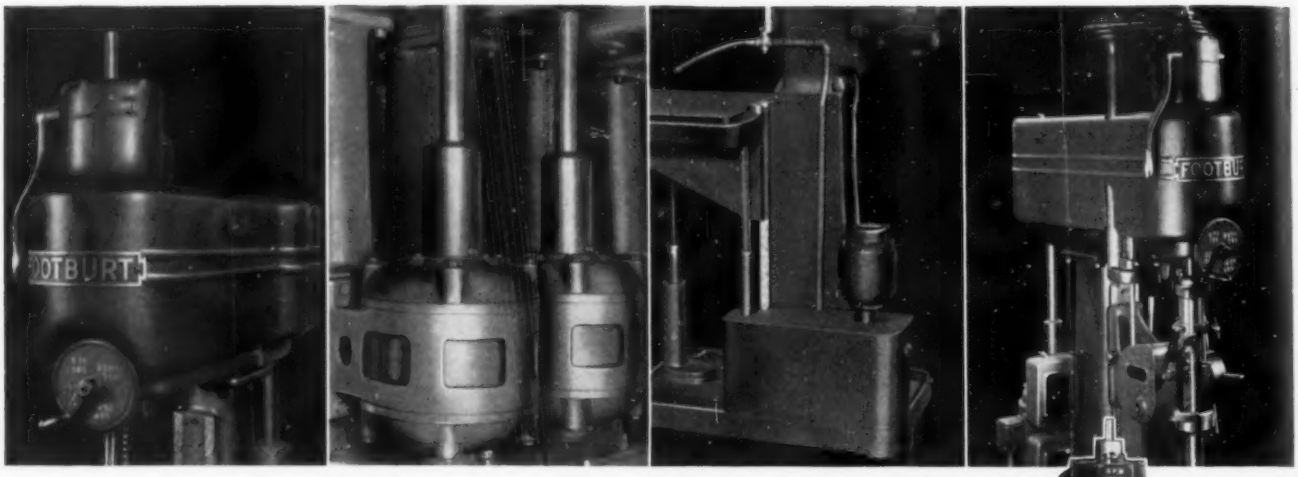
FOOTBURT

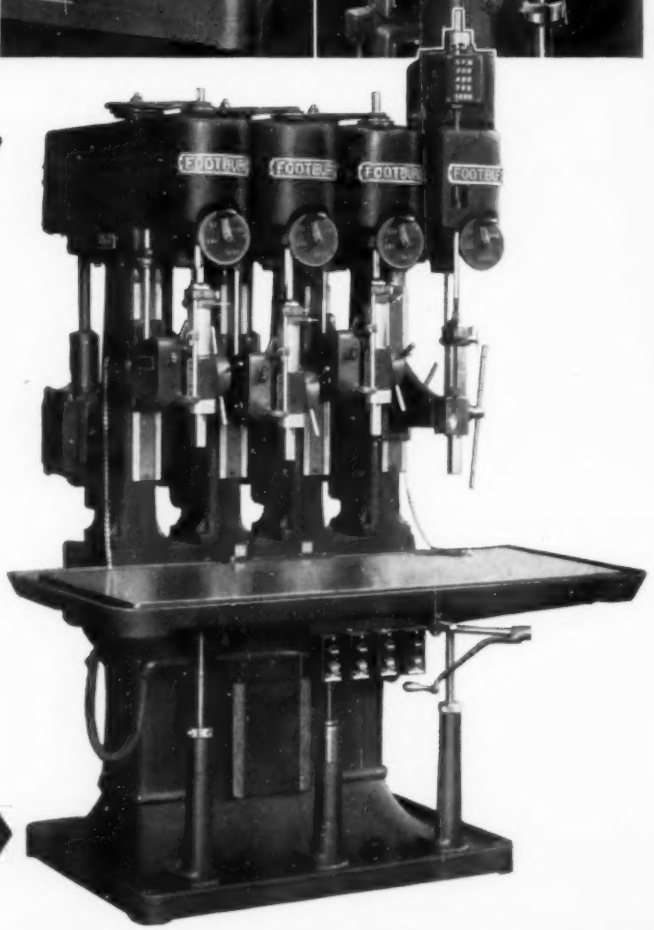
faster for tool room or assembly line



engineered for production

The choice of fine machine tools now will help you meet those new production schedules. Footburt Sensatives are built with the wide range of speeds and with power and sturdiness to drive cutting tools to their full capacity. They are built with the care and precision that will keep them accurate over a long period. Write, wire or phone for prices and delivery information.

THE FOOTE-BURT COMPANY • Cleveland 8, Ohio
Detroit Office: General Motors Building



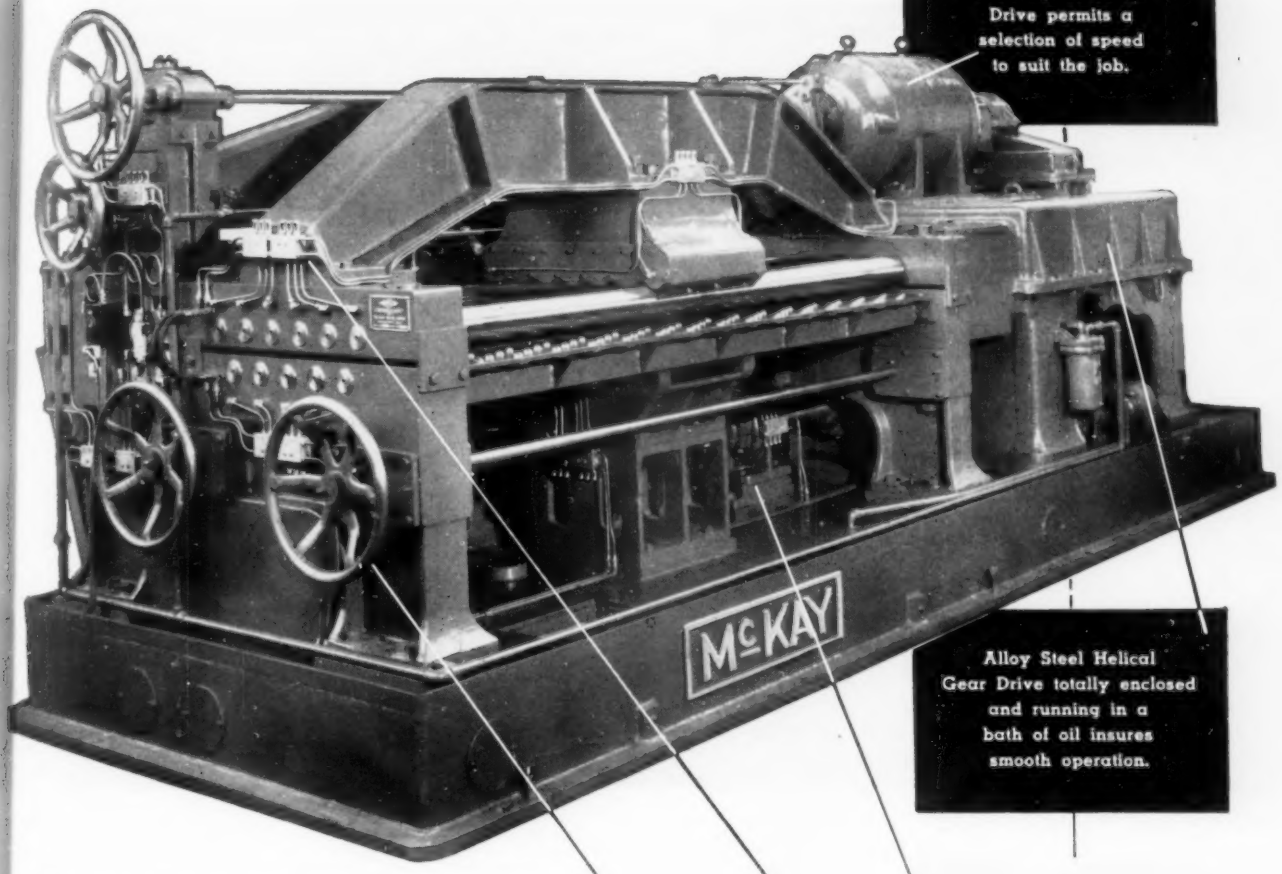
No. 2 Machine with Back Gear • 12" Overhang • ⅜" Drilling Capacity in Steel • Optional Speed Ranges • 185 to 2300 RPM • 280 to 3450 RPM • Vertical Motor Drive with Standard Single Speed Motor • Power Feed Assembly • Tapping Attachment • Coolant Outfit.

FOOTBURT

machine tools—

why do McKay Machines

LAST LONGER ?



Multi Speed Motor Drive permits a selection of speed to suit the job.

Alloy Steel Helical Gear Drive totally enclosed and running in a bath of oil insures smooth operation.

Rugged construction consistent with steel mill design permits continuous operation with a minimum of down time.

One shot system provides correct lubrication for all moving parts.

Compact design with all adjustments easily accessible to the operator.

The McKay Flex Roll Sheet Processor is universally accepted by the automotive and stamping industries for eliminating stretcher strain and reducing scrap loss due to breakage in die drawn parts. The Processor combines a deep flex rolling under tension and a thorough cold working of the steel sheet by roller leveling, to condition it for deep drawing operations.

McK McKAY

The McKAY MACHINE Company

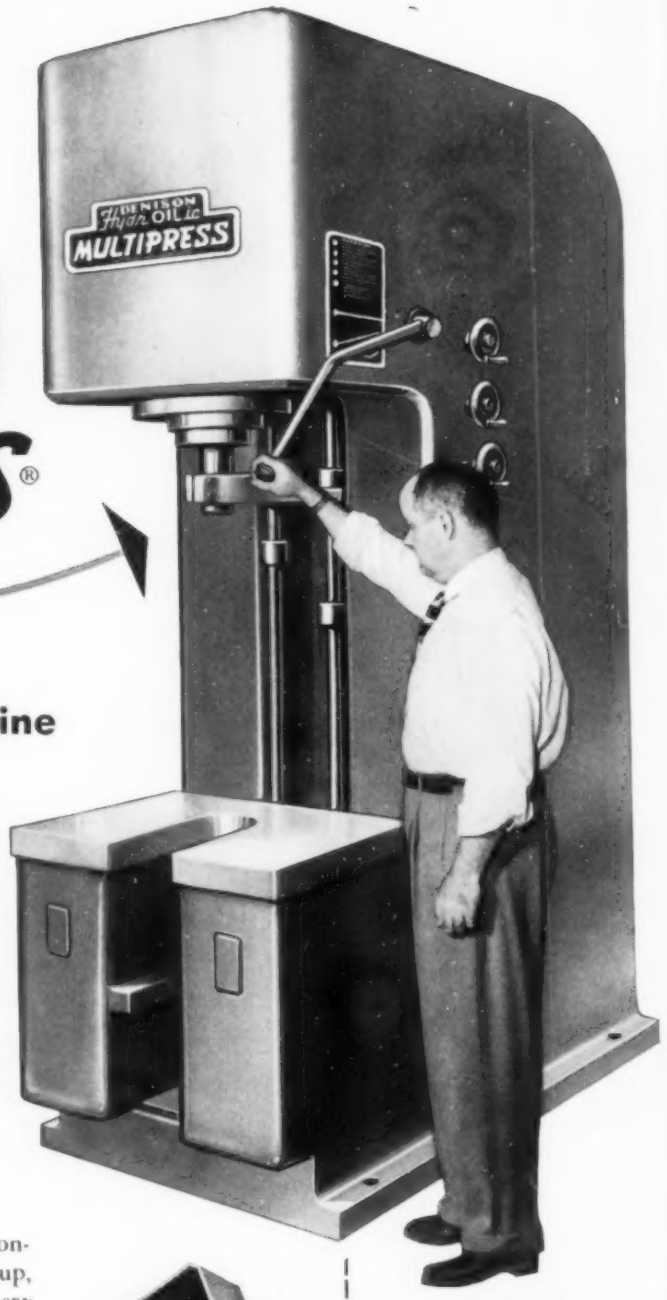
YOUNGSTOWN, OHIO

Engineers and Designers of Equipment for the Automotive, Fabricating and Steel Industries

NOW

75-TON MULTIPRESS®

MODEL QA75



Big-job Multipress added to line

NOW — *all production-boosting Multipress advantages can be applied to jobs calling for pressures up through the 75-ton range!*

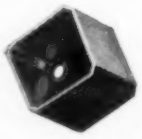
MANUAL OR AUTOMATIC CONTROL: A choice of nine control valves offers manual or automatic operation to suit any need. Dual-push button or hand-lever controls available for extra safety. Hold down and other operating sequences are easily provided.

VERSATILE RAM ACTION: The 15-inch maximum ram stroke of the new 75-ton Multipress is fully adjustable for both upper and lower limits. Pressing and approach speeds are *independently* adjustable. Continuous cycling of automatically controlled ram may be set for either distance or pressure limits.

TOUCH CONTROL: With the New Multipress servo control added, the ram starts, stops, reverses, speeds up, slows down, or applies pressure *in direct relation to every action on the hand lever.*

INDEX TABLE FEEDS AND OTHER ACCESSORIES: Six- and 12-station Multipress Index Tables can be used for fast, automatic, multiple-point feeding or assembly of parts. Many other automatic feeds, auxiliary attachments and work-speeding accessories also available.

The 75-ton Multipress has a 30-inch daylight opening (gap) . . . 34-inch work table width . . . 13-inch throat depth. Height, only 106 inches. *Write* today for full details on this versatile, big-job Multipress. *Other sizes and capacities from one to 50 tons.*



After switching to Multipress, only three draws were needed to form heavy phosphor-bronze housings that required six operations by the former method.

With each ram stroke, Multipress puts 120 close-tolerance notches around a thin-walled compass bezel. Averaging 800 per hour, rejects dropped to .0025%.

With quick, accurate "one-shot" assembly of this 6-part metal and plastic switch component, Multipress boosted output 80% and cut scrap loss 84%.

Multipress increased production speed to 3½ times the previous rate, in staking metal pins in a precision part of a famous-make 3-speed record changer.

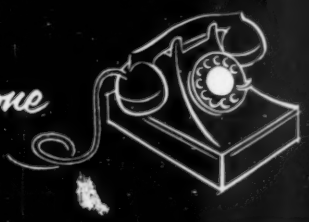
DENISON Hydr OIL ics

The DENISON Engineering Company 1191 Dublin Road, Columbus 16, Ohio

Red Shield says:

"STANDARD for tough jobs since 1881"

as near as your telephone



Call your Industrial Supply Distributor for Shield Brand Reamers. Specialized factory service available everywhere.

STANDARD TOOL CO.

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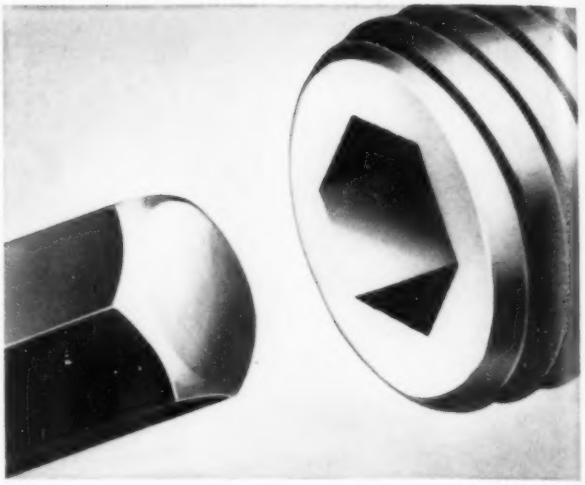
BRISTOL'S HEX SOCKET SCREWS

Meet every requirement of DESIGN, PRODUCTION, *and* MAINTENANCE

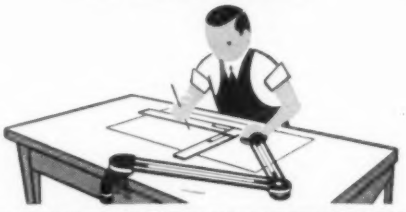
Bristol makes a complete line of socket screw products in sizes from 0 wire to 1 in. in diameter. Standard and listed sizes are stocked in heat-treated alloy steel. Brass, bronze, monel, stainless steel, etc.; are furnished on special order. All Bristol screws are carefully designed to close tolerances (A.S.A. approved, Class 3 fit) and precision-threaded either National Coarse or National Fine.



HERE'S WHAT BRISTOL'S HEX SOCKET SCREW DOES FOR

THE DESIGN ENGINEER

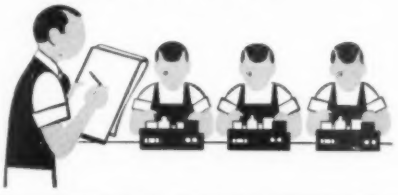
- ✔ withstands shock
- ✔ gives neater, more streamlined appearance
- ✔ provides stronger fastening
- ✔ permits more compact design
- ✔ withstands vibration



THE PRODUCTION ENGINEER

all of the above, *plus*...

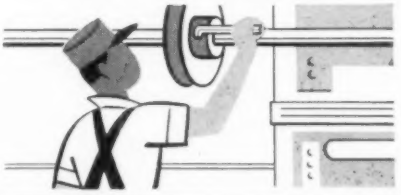
- ✔ saves time
- ✔ provides faster and easier assembly
- ✔ makes for less rejects
- ✔ prevents wrenches from slipping and marring surfaces



THE MAINTENANCE MAN

all of the above, *plus*...

- ✔ provides easy disassembly
- ✔ makes for greater safety



Write for free bulletins showing applications. Only Bristol makes *both* Multiple-Spline and Hex... for severe and regular service.

SET SCREW | FLAT HEAD CAP SCREW | CAP SCREW | SHOULDER SCREW | PIPE PLUG

BRISTOL'S SOCKET SCREWS

Multiple-Spline and Hex Socket Screws. Cap and Set

THE BRISTOL COMPANY, Socket Screw Division, Waterbury 20, Connecticut

A.3.1A

JESSOP Announces the First Complete Line of Tempered-and-Ground Flat Steels in America!

In keeping with Jessop's drive for unqualified leadership in the production of specialty steels, is this new manufacturing development at the Washington mill. Through a continuous process, carefully-controlled, ground-and-polished carbon, alloy, and stainless flat steels in widths up to 24 inches and in all applicable cut lengths, are available in large quantities. For example, the automatic furnace equipment alone is capable of processing a normal 7,000,000 pounds per year. Such steels in quantity were formerly obtainable only in Europe, on an average delivery schedule of at least 18 months. Now, you can get them from Jessop in a few weeks. This new availability should be of high interest to the makers of band saws, paper mill machinery, food packing equipment, textile machinery, and all others that require tempered steel with fine surface finish, flatness, straightness, accuracy of gauge, and exact composition. When inquiring, mention TRU-GROUND, which is the trade name of this new steel . . . this prime example of Jessop enterprise.

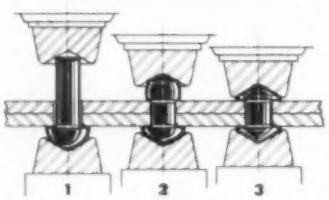
JESSOP

STEEL COMPANY · WASHINGTON, PA.

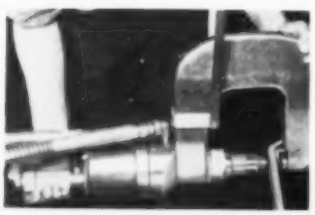
WHY HANNIFIN "HY-POWER" RIVETERS SAVE YOU MONEY

STRONGER JOINTS!

This "silent squeeze" method gives you (1) rapid advance to riveting position, (2) high-pressure shaping of the rivet, cold or hot, and (3) automatic reversal as soon as the rivet is formed. Why are these rivets stronger? Because with this method the rivet shank expands to completely fill the hole and, as the metal flows to shape the heads, fillets are formed under both heads. The rivet is work-hardened, too, and every rivet is uniform.



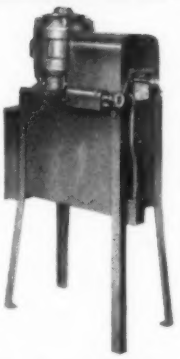
FASTER RIVETING!



Yes! From the time the button is touched it takes only 2½ seconds to head a ⅜" rivet. *"Hy-Power" is safe, too!* For the stroke can be interrupted and the ram reversed automatically anywhere in the cycle, simply by releasing the control button.

QUIETER OPERATION!

Here's the power source for this modern riveting method . . . it's the Hannifin "Hy-Power" Generator. This compact unit is a combination of motor, pump, oil reservoir, automatic control valves and high pressure intensifier that quietly supplies hydraulic pressure to...



...your "Hy-Power" cylinders—available in 7½, 10, 12½, 17½, 25, 35, 50, 75 and 100-ton capacities (more in multiple). Cylinders can either be mounted in yokes (portable or stationary) or installed in machines of your design.

GET THE FACTS!

Get Bulletin 150. Learn why cost-conscious firms in many fields use "Hy-Power." Just write for your copy of this 32-page book. We'll mail it promptly.

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Air and Hydraulic Cylinders • Hydraulic Presses • Pneumatic Presses • "Hy-Power" Hydraulics • Air Control Valves

CLEEREMAN DRILLING MACHINES

LOWEST Operating Costs!

Why?

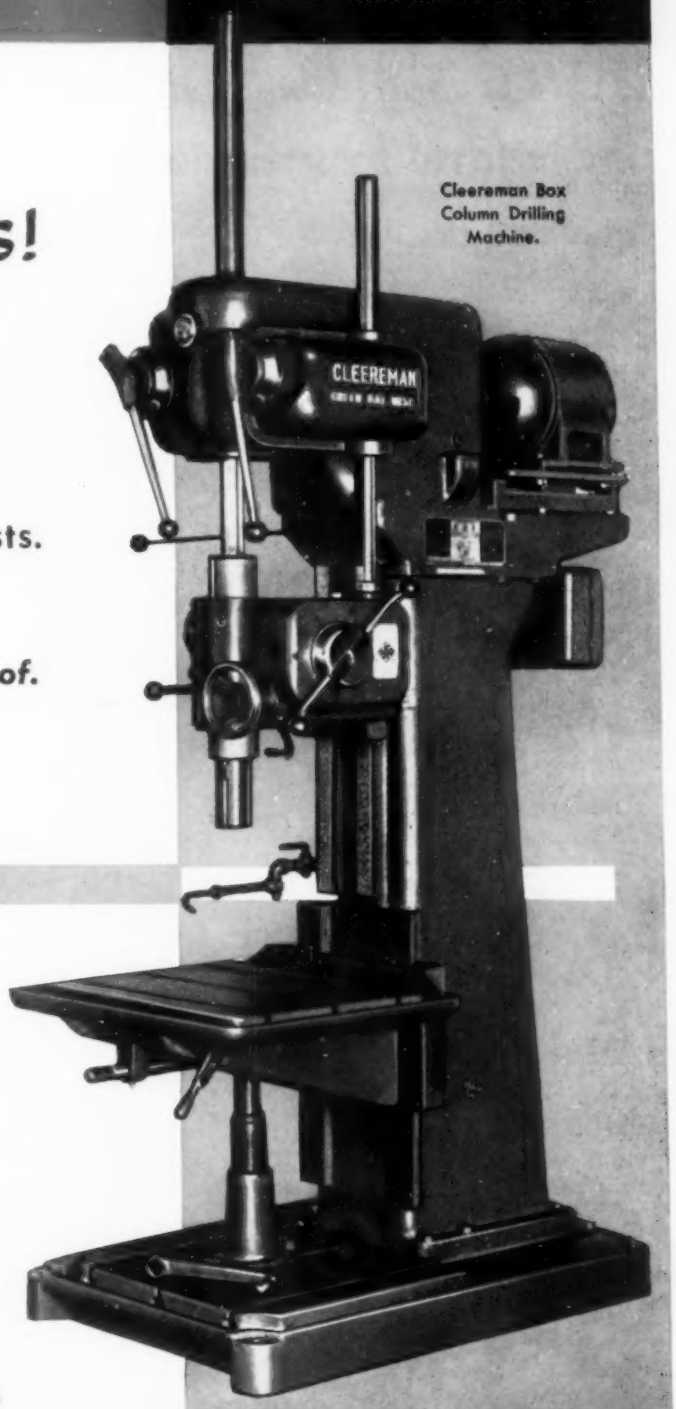
1—Eliminate Down Time.

2—More Power to Produce.

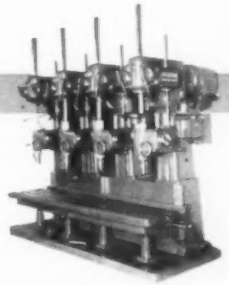
3—Lowest Maintenance Costs.

4—Less Operator Fatigue.

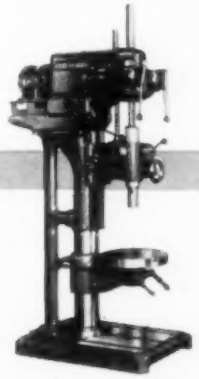
Go to any Cleereman user for proof.



Cleereman Box Column Drilling Machine.



Cleereman Multiple Drilling Machine.



Cleereman Round Column Drilling Machine.

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• Company •
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Representatives in Principal Cities

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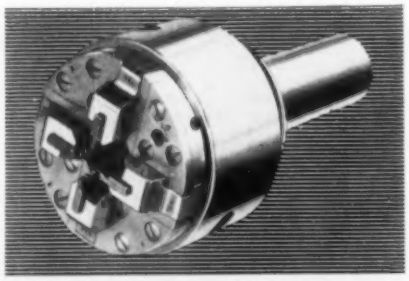
CLEEREMAN MACHINE TOOL CO. Green Bay, Wisconsin

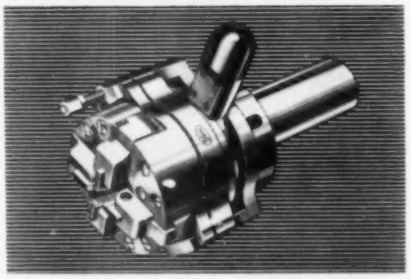
BUILDERS OF PRECISION JIG BORERS AND DRILLING MACHINES

An IDLE man at a BUSY automatic spells PROFIT. ¶ A BUSY man at an IDLE machine spells LOSS. ¶ H&G Insert Chaser Die Heads are preferred by screw machine engineers because they spell less down time, lower costs, cleaner, more accurate threads. ¶

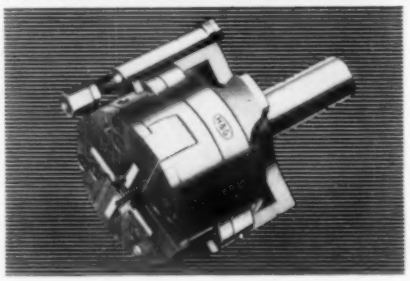
Style MM
for multiple spindle automatics, chucking machines, drill presses.



Style DMS
for hand screw machines, turret lathes, where die head does not rotate.



Style DM
for B & S automatics and small spindle machines.



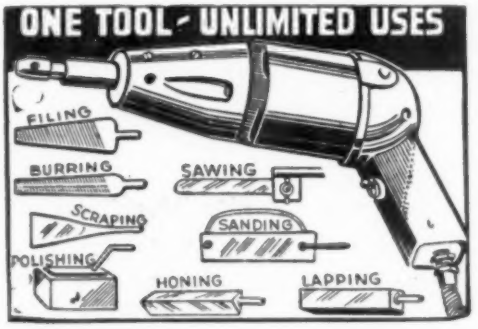
H&G Insert Chaser DIE HEADS

WRITE FOR "HOW TO SELECT THE PROPER DIE HEAD FOR THE JOB".

THE EASTERN MACHINE SCREW CORPORATION
27-47 Barclay Street, New Haven, Conn.

USE READER SERVICE CARD; INDICATE A-4-208-1

B-R-E-A-K . . . .
Hand Finishing Bottlenecks
with PORTABLE - ELECTRIC RECIPROCATING TOOLS



These handy tools will cut out many tedious hand filing and finishing operations—Increase Production—Produce Uniform Work.

Light in weight—Delivers 1/8" or 3/8" fixed stroke at 1000 strokes per minute—Operates on 110 volts AC or DC.

ACME TOOL COMPANY
75 W. Broadway New York 7, N. Y.

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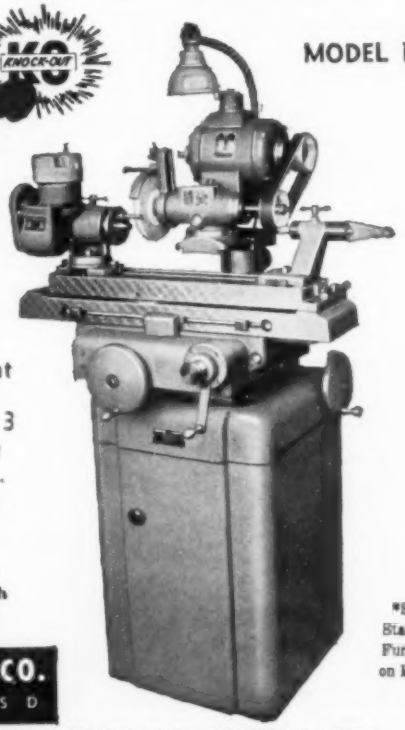
There's a reason 76%*
of all popularly-priced Tool and Cutter Grinders sold in 1952 were "Knock-Outs"

MODEL B860



Will do anything that machines costing 2 or 3 times more will do . . . yes and in less time.

Distributed Only Through Franchise Dealers

K. O. LEE CO.
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*Sales Statistics Furnished on Request

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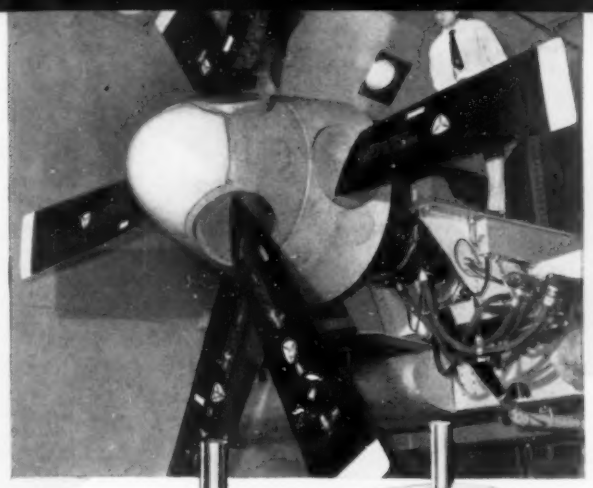
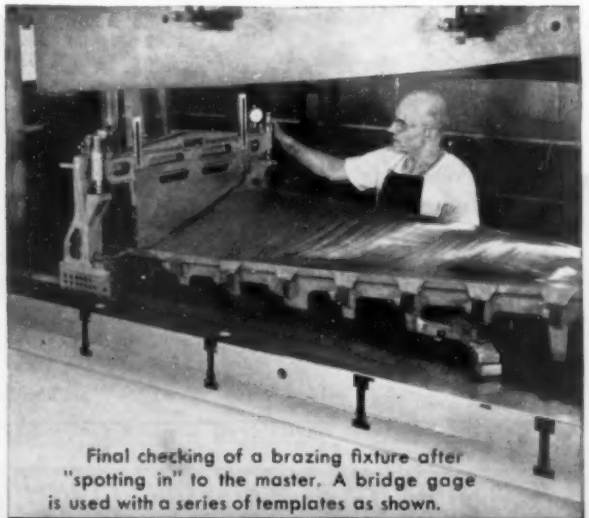


High speed aircraft propeller on test stand—built from tools "spotted in" in a DANLY SPECIAL DIE SET.

DANLY SPECIAL DIE SET, 46 by 140 inches, used for both production and checking of aircraft propeller tools.

DANLY SPECIAL DIE SETS



Final checking of a brazing fixture after "spotting in" to the master. A bridge gage is used with a series of templates as shown.

DANLY

DIE SETS AND DIEMAKERS' SUPPLIES

DEPENDABLE FOR ACCURACY

Here's proof . . . this Danly Special Die Set is used by one of the country's leading aircraft propeller manufacturers for "spotting in" all contour tools for a complete production line. Accuracy is a must because the tools, masters for duplicating planers and profilers as well as holding fixtures, must mate closely with the master pattern and with each other in the sequence of operations.

Dependable accuracy makes Danly Special Die Sets ideal for applications of this kind . . . and rugged construction makes them last longer, too, on any job. That's why leading diemakers everywhere prefer Danly Die Sets!

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2100 South Laramie Avenue • Chicago 50, Illinois

DANLY SPECIAL DIE SET SERVICE IS FAST AND CONVENIENT—CALL YOUR NEAREST DANLY BRANCH

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*Indicates complete stock

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Surface Grinding to Gage Tolerance?

Dependable Grinding Performance in Production?

Positive Dust Protection?

. . . if so, Boyar-Schultz No. 6-12 is the Surface Grinder for YOU!

It has the capacity to handle the biggest part of the tough assignments encountered in any shop. It has the accuracy to obtain the high precision needed in tool and gage making. In production it proves so sturdy that long runs, with accuracy, are no problem.

The New Dust Collector, made specially for No. 6-12 Surface Grinder is furnished as optional equipment and is built into the Grinder at the factory. With this Dust Collector, no more floor space is required.

BIG MACHINE PERFORMANCE—Small Machine Cost

BOYAR-SCHULTZ CORPORATION

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featuring

Continuous change in lead angle to compensate for continuous change in diameter.

- This feature insures uniform depth of radial undercut (shear) on the entire length of the taper and provides uniform relief at all points on the diameter.
- In stock for immediate delivery sizes #6/0 thru #10. Made promptly to order sizes #11, 12, 13, and 14.
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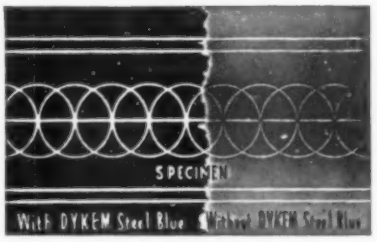
DYKEM STEEL BLUE

STOPS LOSSES

making dies & templates



Simply brush on right at the bench; ready for the layout in a few minutes. The dark blue background makes the scribed layout show up in sharp relief and at the same time prevents metal glare. Increases efficiency and accuracy.

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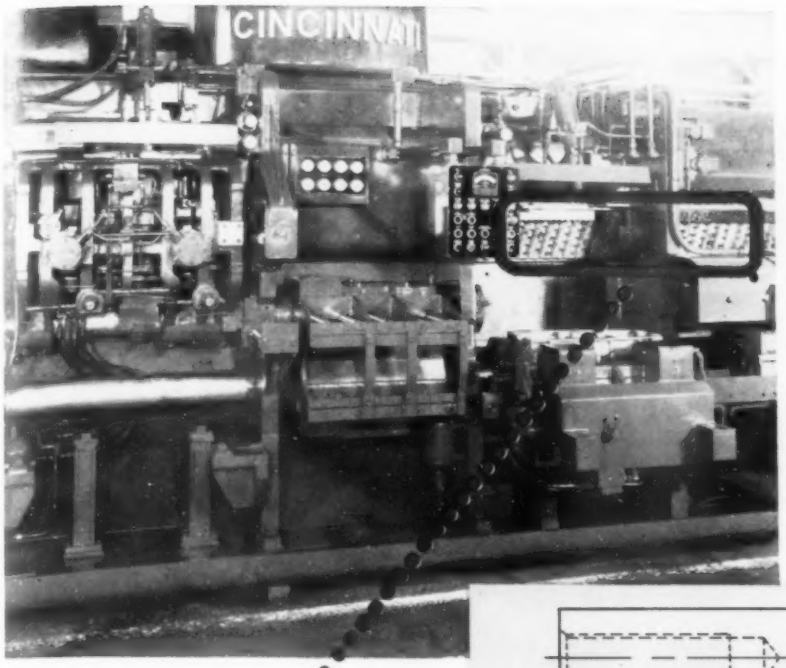
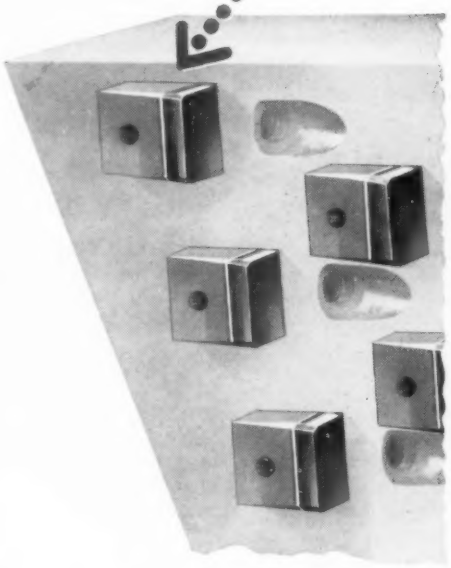
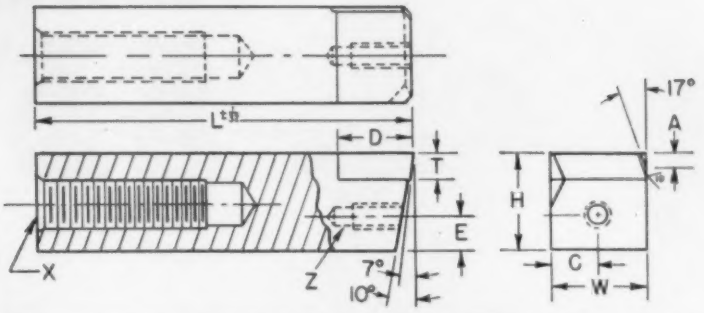


First again...

Firthite tipped Broach Tools for Off-the-shelf delivery!



FIRTHITE standard broach tools are carefully manufactured with special alloy steel shanks, drilled and tapped as shown in the dimensional drawing.



LEFT HAND	RIGHT HAND	W	H	L	T	D	A	C	E	X	Z
CBL-10	CBR-10	.610 .613	.613 .611	2¼	5/32	5/16	3/64	0	0	¼-20 N. C.	NONE
CBL-12	CBR-12	.735 .739	.737 .739	3	3/16	3/4	3/64	0	0	3/8-24 N. F.	NONE
CBL-16	CBR-16	.988 .983	.988 .986	3 13/16	¼	3/4	5/32	.500 .490	3/8	½-20 N. F.	¼-20 N.C.

3 Standard Sizes Available for High Production Broaches

Firth Sterling, always a leader in machine tooling progress, now offers *standard* broach tools for *off-the-shelf delivery* in the sizes and styles shown above.

This new addition to the constantly expanding line of standard Firthite Carbide Tools is the result of close cooperation with the builder of the huge new broaching machines used to machine the cylinder blocks of today's mass-produced automobile engines.

The proved performance of Firthite broach tools in this application, and the continuing demand for them, enables us to make stock items of these tools that help reduce costs and improve quality in the production line. Solid Firthite finishing blades are also quickly available.

Now, automobile and other manufacturers can keep broach tool inventories at a minimum and still be assured of prompt delivery when needed. Literature or engineering information is available, without obligation.

R-279

High Speed Steels • Tool & Die Steels • Stainless Specialties • High Temperature Alloys
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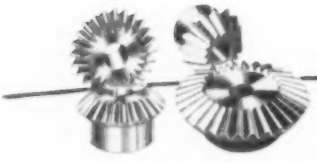
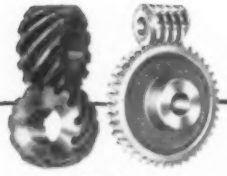
Design Around

SPUR GEARS — PINIONS
CHANGE GEARS

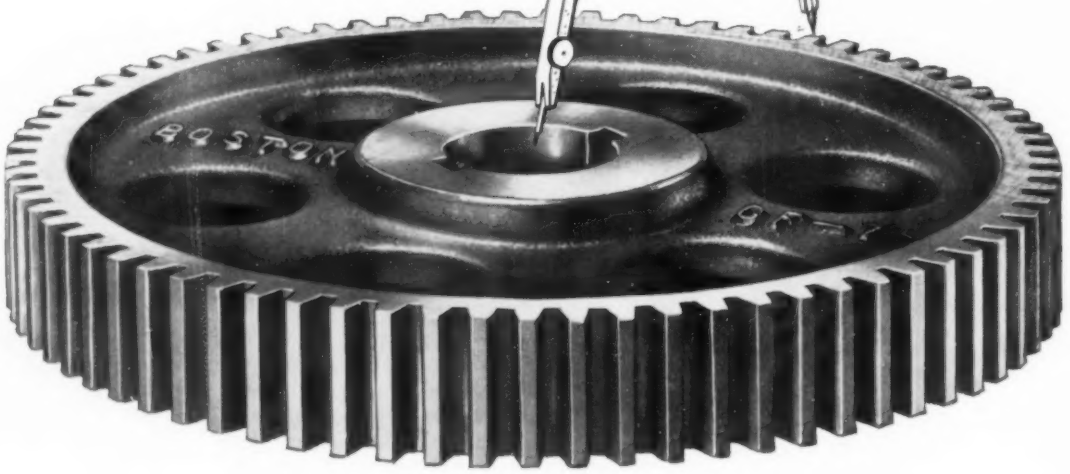


MITRES — BEVEL GEARS



HELICALS
WORMS and WORM GEARS

CHAIN and
SPROCKET



BOSTON GEAR CATALOG

Lists all gears and other BOSTON Products. Contains time-saving information on gear selection and useful reference data. Ask your Boston Gear Distributor . . . . or write: Boston Gear Works, 83 Hayward Street, Quincy 71, Mass.

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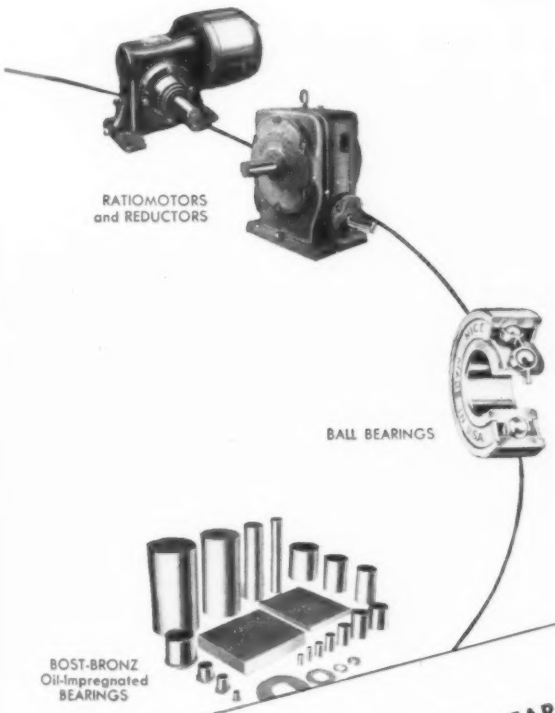

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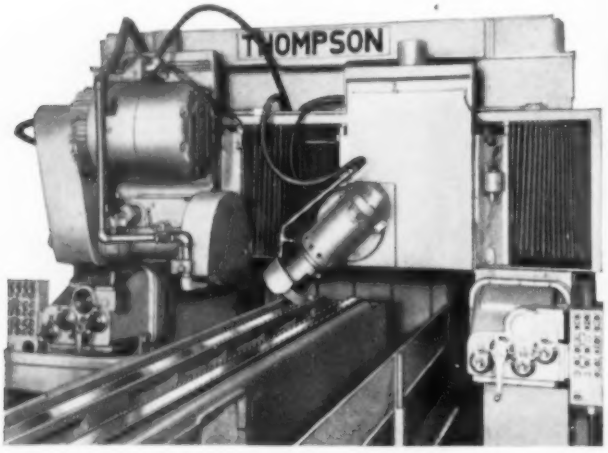
Let **BOSTON** *be your "buy-word"*

New Thompson Way Grinder Developments

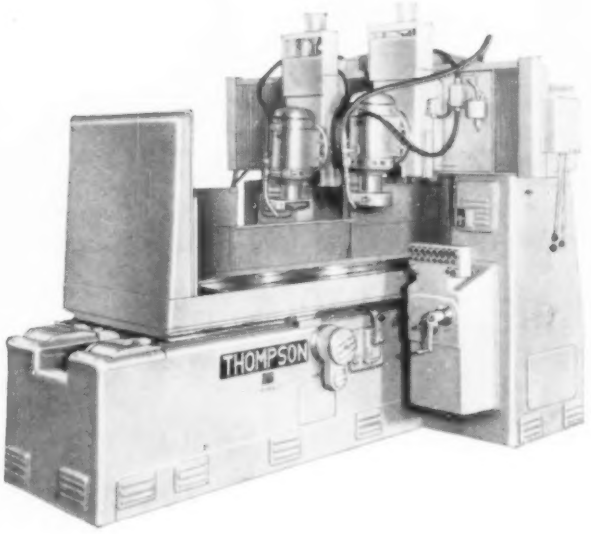
Reduce Costs ... Speed Machine Tool Production

Way Grinders now available with single, multiple heads, or combinations of horizontal and vertical heads and in sizes to meet all requirements.

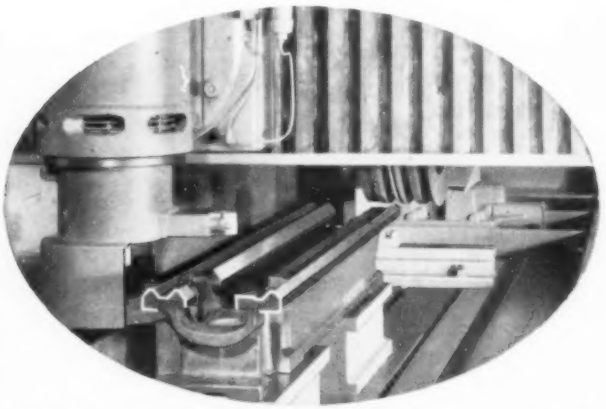
Thompson has produced machine tool way grinders in many types and sizes that have eliminated hand-work and produced economical and accurate ground ways. However, recently increased production grinding of ways has been made possible by many new Thompson Way grinding developments such as: automatic grinding and truing cycles; dual vertical or horizontal heads for grinding ways different heights; horizontal multi-wheel grinding and vertical side and undercutting head; Hydrail way grinding for giant columns or bed ways. Three of the new Thompson Way Grinders are shown here.



Designed especially for extremely large machine tool way grinding is this typical Thompson Hydrail Way Grinder. Size 48" x 48" x 192". Part: grinder bed ways.



One of several new Thompson Double Head Dovetail Way Grinders installed to speed work and hold accuracy in the plant of a leading lathe manufacturer.



Multi-wheel grinding with auxiliary vertical head. Equipped with horizontal spindle having dual spaced wheels and auxiliary inclinable spindle. The front contoured grinding wheel grinds the rear set of ways and the rear grinding wheel grinds the front set, with vertical head grinding the sides and undersurface of the ways and rack seat.

Write for details Today.

The Thompson Grinder Company, Springfield, Ohio

Thompson SURFACE Grinders

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BAUMBACH DIE SETS GET THERE FASTER!

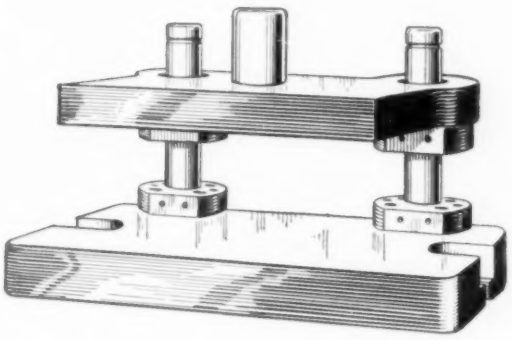

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Photo Courtesy Boye & Emmes Machine Tool Co.

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Gusher Coolant Pumps are designed to give you years of dependable service.

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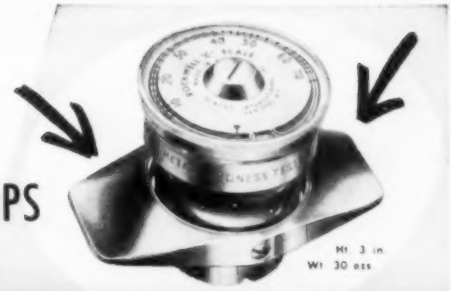

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INSERTED-BLADE MILLING CUTTERS AND SINGLE-POINT TOOLS FOR ALL METAL-CUTTING NEEDS

APEX TOOL BITS FIT MOST STANDARD HOLDERS

If you haven't yet changed to Apex, you can get acquainted with APEX QUALITY by using Apex tool bits in your present holders. The Apex line includes Single-Point, Round Shank, as shown above, and Shankless Serrated. There are also Apex inserted-blade cutters of many styles: Millers, End Mills, Reamers, Slotters—you name it, we'll supply it!

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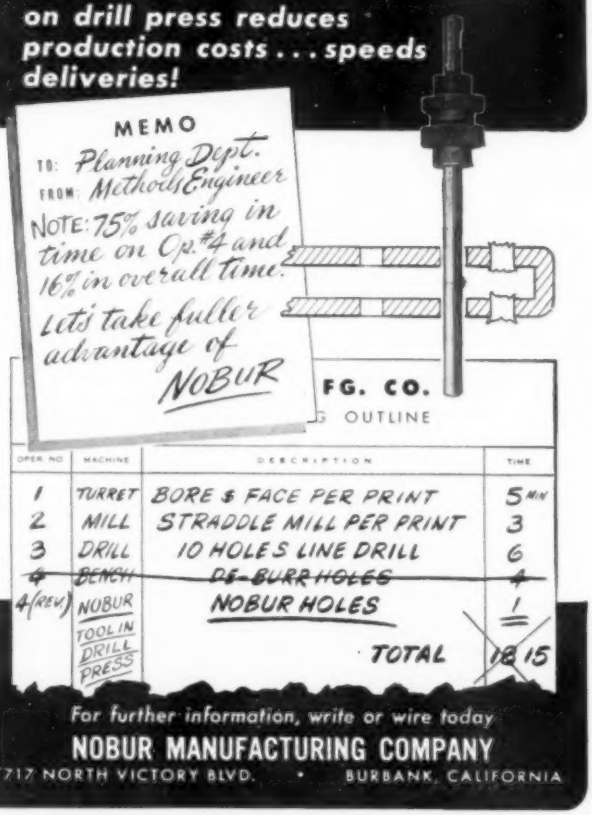
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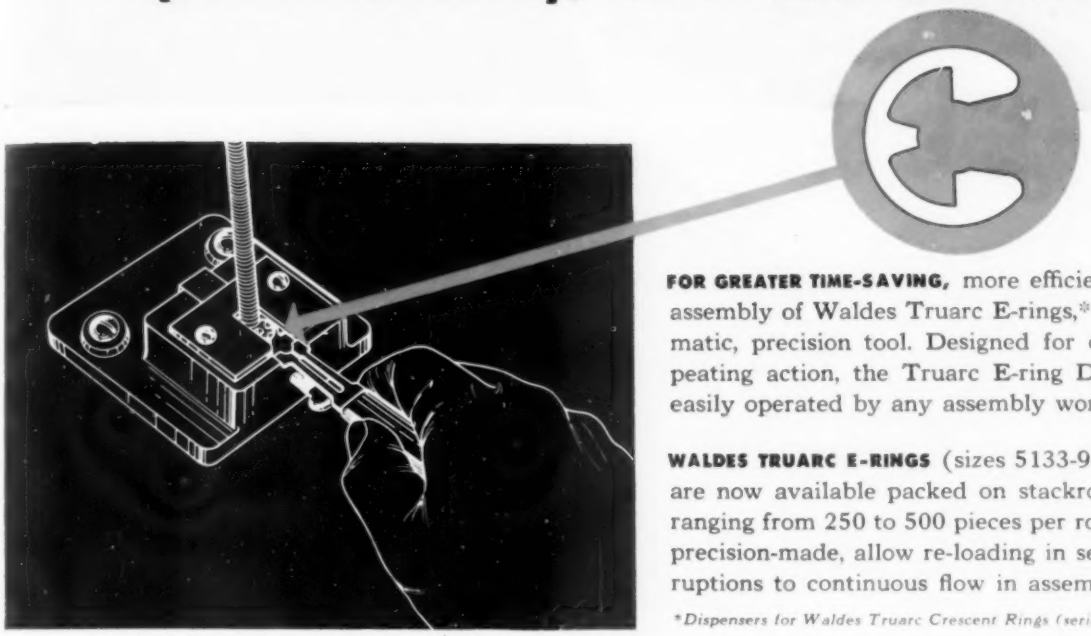
New Waldes Truarc E-Ring Dispenser* Speeds Assembly, Cuts Time and Costs



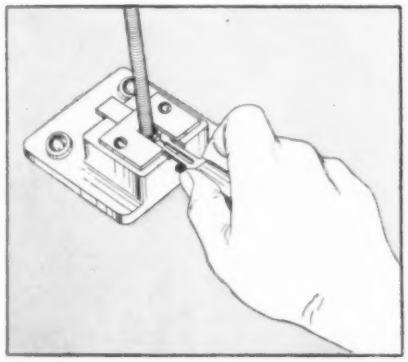
*U. S. PAT. PENDING

FOR GREATER TIME-SAVING, more efficient handling and assembly of Waldes Truarc E-rings,* here is an automatic, precision tool. Designed for one-at-a-time repeating action, the Truarc E-ring Dispenser can be easily operated by any assembly worker.

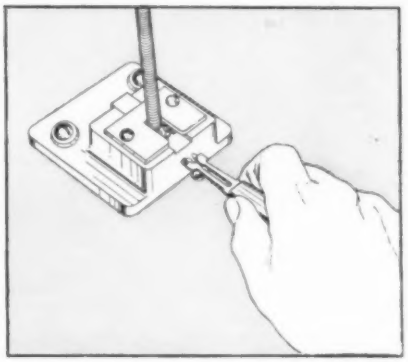
WALDES TRUARC E-RINGS (sizes 5133-9 to 50 inclusive) are now available packed on stackrods in quantities ranging from 250 to 500 pieces per rod. Stackrods are precision-made, allow re-loading in seconds. No interruptions to continuous flow in assembly.

**Dispensers for Waldes Truarc Crescent Rings (series 5103) also available.*

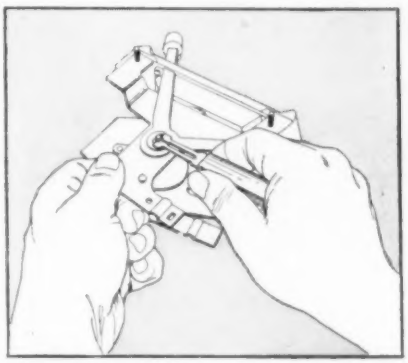
SIMPLE 1, 2, 3 ASSEMBLY OPERATION



1 Truarc applicator is pushed forward and grips a single E-ring.



2 Applicator withdrawn (new ring automatically feeds into place).



3 Ring is installed in groove on shaft. No waste time or motion.

WRITE, TODAY, FOR COMPLETE BROCHURE ON WALDES TRUARC E-RING DISPENSER

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Tool Steel Topics

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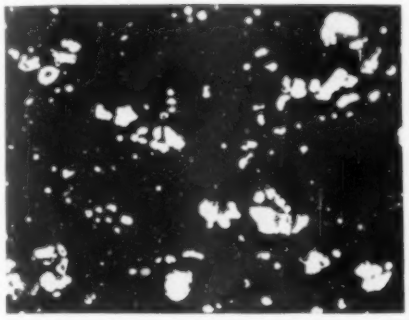
Ten Times More Necktie Clasps with Hobbed Molds of Duramold A



The white particles are extremely hard carbides which are distributed throughout this hardened structure of Lehigh H, enlarged 500 times in this micrograph.

These Two Carbide Steels for High Wear-Resistance

We're talking about Lehigh H and Lehigh S, two of our high-carbon, high-chromium grades of tool steel. Both are classed as carbide steels because they're intermediate between low-alloy tool steels and sintered carbides.

Lehigh H contains about 20 pct of carbide by volume, and Lehigh S about 30 pct. It's this high percentage of carbides that makes them wear and wear, even on severe jobs.

In actual service, the "soft" material (around Rockwell C-60) wears out between the carbides, leaving the carbides protruding just like individual stones in a cobblestone street. Lehigh H and S, with their abundance of hard carbides, far outwear lower-alloy tool steels.

Lehigh H is the most popular type of air-hardening tool steel where maximum production and freedom from distortion are essential. It's the general-purpose grade. Lehigh S has a higher carbon content to provide still greater wear, but at some sacrifice of shock-resistance.

Lehigh H is stocked in our mill depot in a wide range of sizes. It's also available from local stocks of Bethlehem tool steel distributors in principal cities.

Like to know more about these long-wearing die steels? Write us for Booklet 262. It gives details of both our oil- and air-hardening grades. Address your request to Publications Department, Room 1040, Bethlehem, Pa.

Here's another enthusiastic report on Duramold A, our 5 per cent chromium, air-hardening hobbing steel. Hobbed for zinc die castings, this special-purpose steel has upped the life of molds by at least 1000 pct, according to Peerless Engineering Co., Inc., South Gate, Calif. In the casting of novelty necktie clasps, the die sets of Duramold A were examined at a time when previous molds had to be discarded. The Duramold A cavities showed no evidence of checking or sinking; and the surface finish appeared to have actually improved with use.

M. T. Derby, chief tool engineer for Peerless, sums it up:

"We like Duramold A because it's easy to hob. In making multiple cavities we get good detail and accuracy with fewer machine-hours. For most of our work we need a steel that gives us a high polish in the cavities with a high hardness that will stand up under zinc-injection molding at high pressures and temperatures. We've found Duramold A to have good core strength, it doesn't sink readily, and we can expect to get long runs with very little maintenance."

Whether used for die-casting or plastic-molding Duramold A is a real improvement over hard-to-hob steels. Its 5 pct chromium content provides plenty of wear-resistance and core strength . . . and its air-hardening properties hold distortion to a minimum during heat-treatment. Its typical analysis:

C	Mn	Si	Cr	Mo
0.07 max	0.40	0.20	4.50	0.45

Duramold A is hobbed in one push in a 300-ton press by the master hob shown at top. Eight necktie clasps are cast at one time, the molten zinc being injected at 800 F and 2000 psi; mold temperatures reach about 500 F.

Booklet 271 will help you select the right tool steel—for hobbed molds, machine-cut molds, or master hobs. Address your request to our Publications Department, Room 1041, Bethlehem, Pa.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Here's why upset-forged discs are best for some tools

Like wood, steel has a grain. Tool steel discs which have been upset-forged have a grain-flow parallel to the disc face. When a disc is cut from bar stock, the grain flow is at right angles to the disc face. Before making tools from round discs, it's best to consider the importance of the direction of grain flow.

A milling cutter, for example, made from an upset-forged disc has a radial grain-flow in the cutting teeth. There's less chance of having these teeth break out than if the cutter were made from a disc cut from a bar.

Upset-forged discs are made by upsetting a piece of tool steel which is twice as thick as the desired thickness of the disc. This upset ratio of 2 to 1 should not be varied too greatly. A ratio of more than 3 to 1 will cause buckling during upsetting; less than 1.5 to 1 will not produce the desired flow lines of the grain

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Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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A milling cutter, for example, made from an upset-forged disc has a radial grain-flow in the cutting teeth. There's less chance of having these teeth break out than if the cutter were made from a disc cut from a bar.

Upset-forged discs are made by upsetting a piece of tool steel which is twice as thick as the desired thickness of the disc. This upset ratio of 2 to 1 should not be varied too greatly. A ratio of more than 3 to 1 will cause buckling during upsetting; less than 1.5 to 1 will not produce the desired flow lines of the grain

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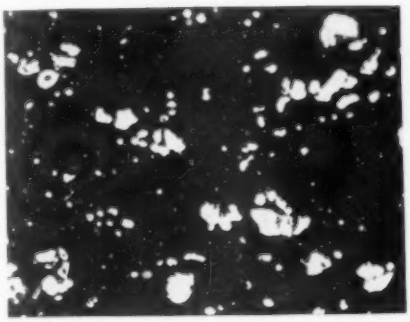

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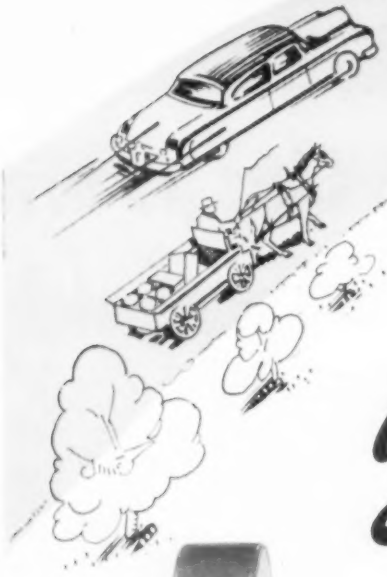

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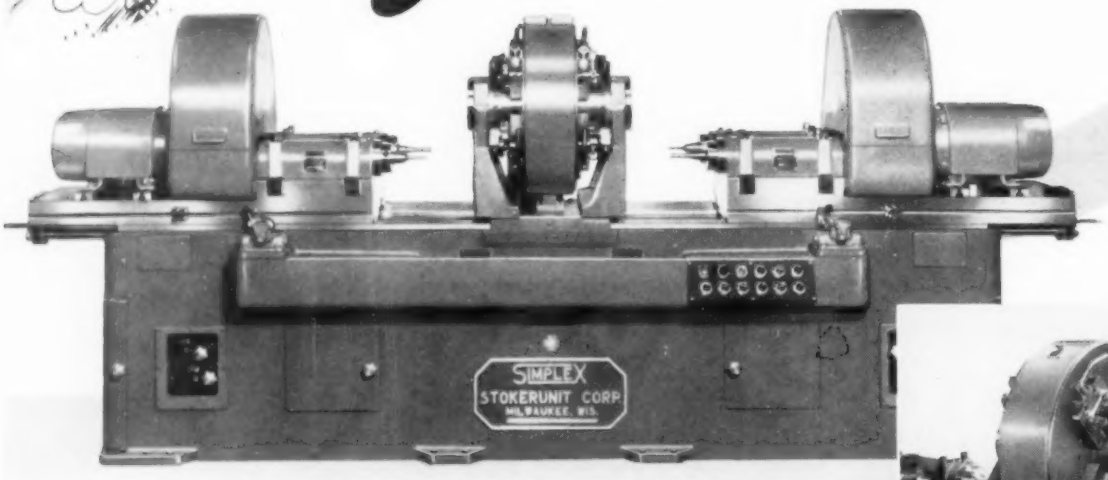

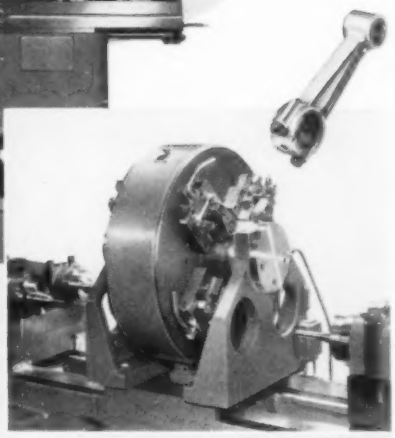

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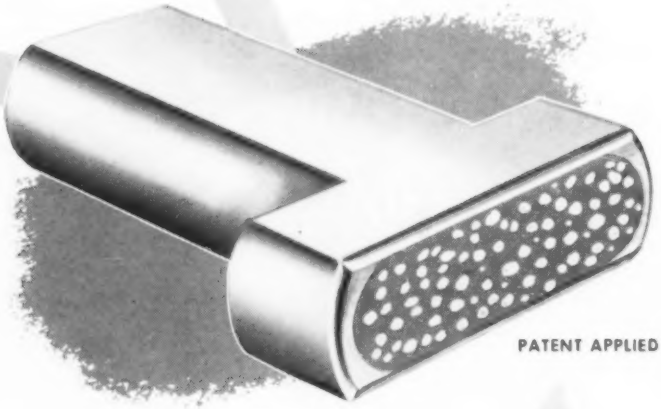

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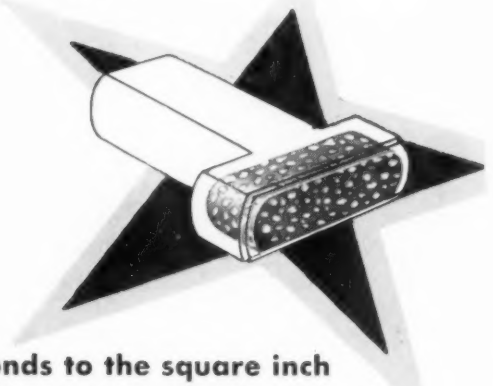

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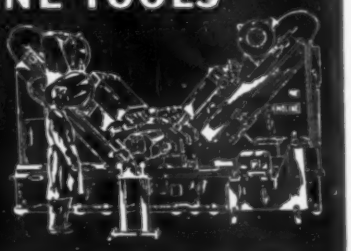

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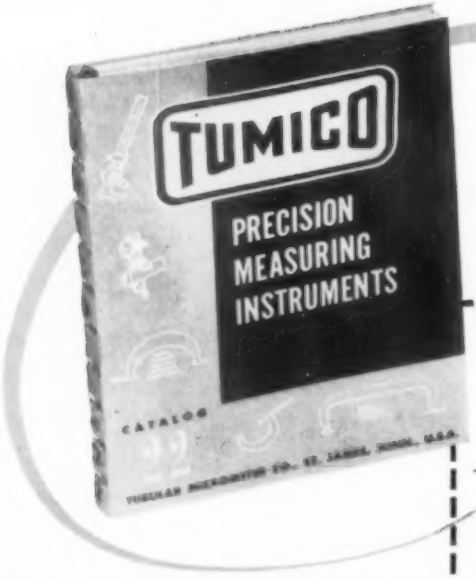

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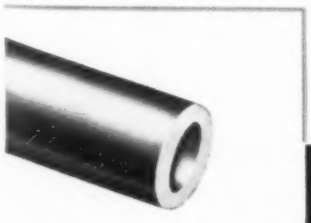

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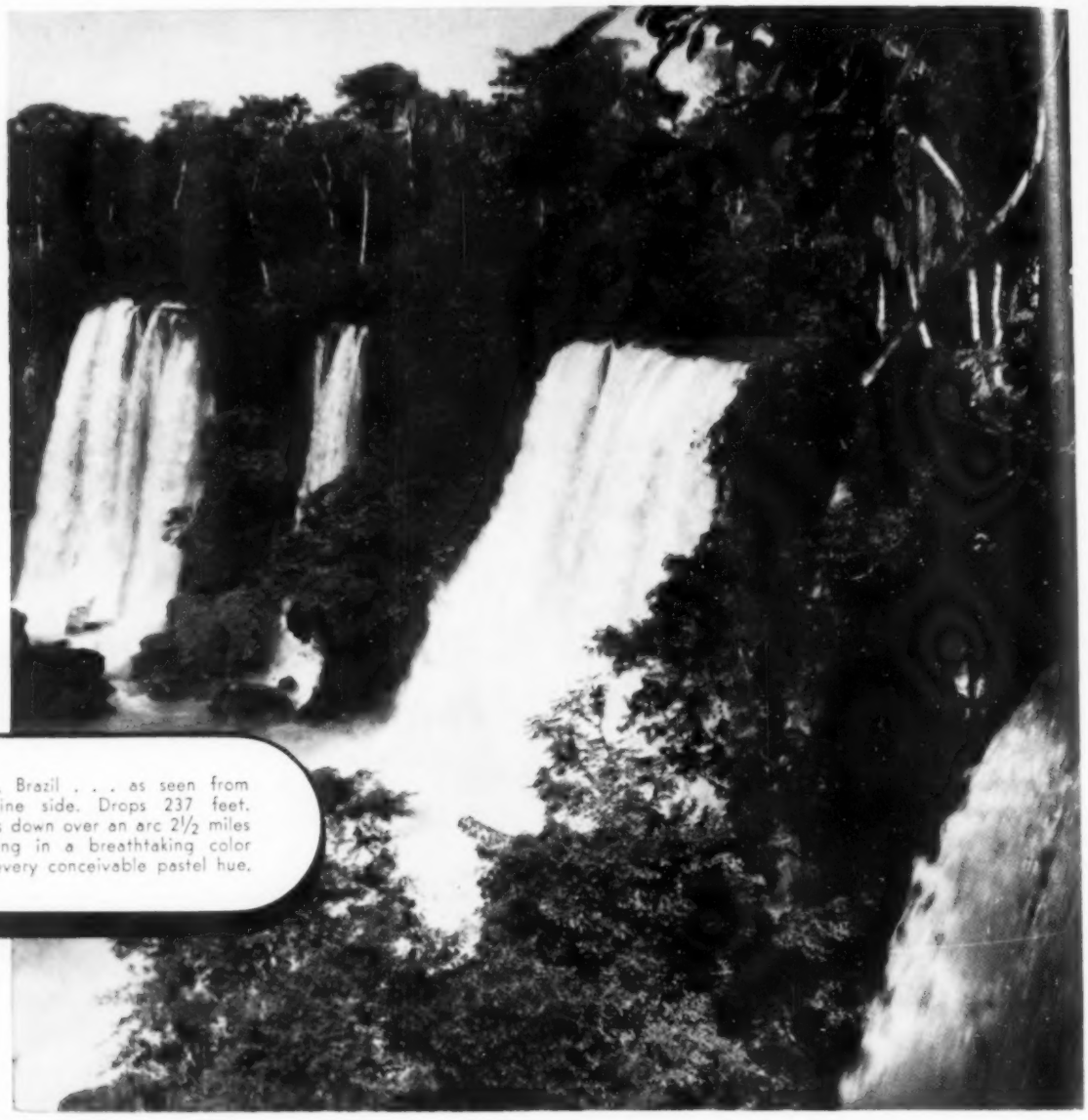


Igussu Falls, Brazil . . . as seen from the Argentine side. Drops 237 feet. Water swirls down over an arc 2½ miles wide resulting in a breathtaking color display of every conceivable pastel hue.

LOGAN *AIR-DRAULIC® FEED-CONTROLLED* CYLINDERS

POWER MOVEMENTS IN ANY DIRECTION — NO POWER UNIT REQUIRED

COMBINES

the fast-acting, economical low pressure operation of

AIR

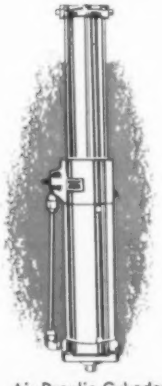
with the smooth, uniform controlled regulation of

OIL

5 ***STANDARD MOUNTING TYPES***

Standard bores from 3" to 8". Any stroke to 5 feet. For air pressures to 150 p.s.i.

Furnished for controlled feed with rapid return in either direction, or with controlled feed in both directions. Skip-feed movement can also be provided.



Air-Draulic Cylinder with Flange Mounting at Rod End

LOGAN MANUFACTURES 6,975 STANDARD CATALOGED ITEMS

FREE CATALOG ON REQUEST

AIR CONTROL VALVES, Cat. 100-4 • AIR CHUCKS, Cat. 70-1 • AIR CYLINDERS, Cat. 100-1 • AIR-DRAULIC CYLINDERS, Cat. 100-3
AIR and HYDRAULIC PRESSES, Cat. 51 • COLLET GRIP TUBE FITTINGS, Cat. 200-5 • HYDRAULIC CONTROL VALVES, Cat. 200-4
HYDRAULIC CYLINDERS, Cats. 200-2; 200-3 • HYDRAULIC POWER UNITS, Cat. 200-1 • SURE-FLOW COOLANT PUMPS, Cat. 62

SAVES TIME — Logan — AIR AND HYDRAULIC EQUIPMENT — EFFORT-MOTION

LOGANSPORT MACHINE CO., INC., 839 CENTER AVE., LOGANSPORT, IND.

BAY STATE MOUNTED POINTS and WHEELS

INDICATOR ACCURACY

Best because:

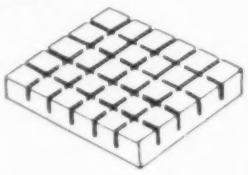
Precision Shaped

on the spindle for perfect contour and complete concentricity.

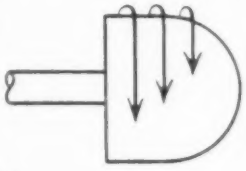
You get . . .

UNIFORM, SAFE, PRECISE PRODUCTION

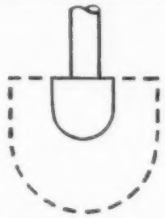
1. UNIFORM



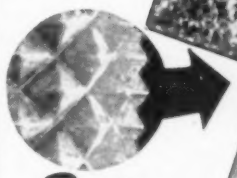
2. SAFE



3. ACCURATE



4. DURABLE



Deep-Knurling

for EXTRA SAFETY, in high-strength alloy steel spindles. THE HEADS STAY ON!

Specially Cemented

USE THEM . . . right down to the spindle!

Wrench-and-vise test proves its strength. This cement HOLDS, under EXTREME STRAIN.

1. Made from solid blocks of perfectly mixed materials.
Result: Complete elimination of "hard and soft" spots.

2. Deep-knurled, high strength alloy steel spindles, and special adhesive.
Result: Abrasive heads stay on spindles.

3. Each wheel trued and shaped after mounting on its spindle.
Result: Perfectly concentric; ready to use when you get it.

4. Completely uniform structure; pretested, positive bonding.
Result: Longer useful life; use them right down to the spindle.

BAY STATE ®

WIDE RANGE OF SHAPES & SPECIFICATIONS AVAILABLE FOR IMMEDIATE SHIPMENT

SEND FOR CATALOG

BAY STATE ABRASIVE PRODUCTS CO.
Westboro, Massachusetts, U. S. A.

Branch Offices and Warehouses:
Chicago, Cleveland, Detroit, Pittsburgh
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In Canada: Bay State Abrasive Products Co. (Cana

PARKER · MAJESTIC PM PRECISION MACHINES

Pictured here is the home and products of

PARKER-MAJESTIC, INC.

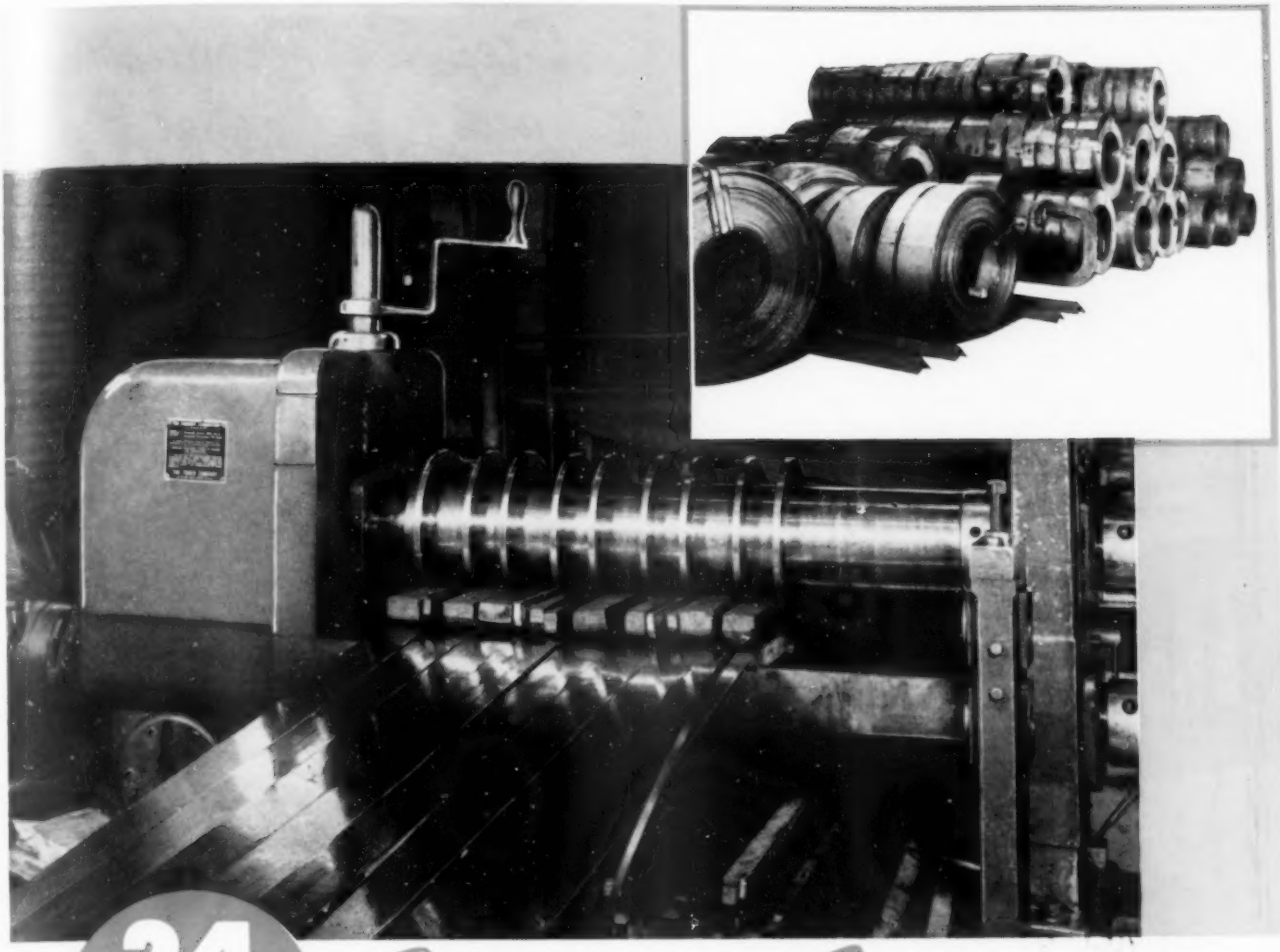
For almost a quarter of a century this company has manufactured the **Parker** Spindles used in Precision Grinding, Boring and Milling applications. Additional products include the well known line of **Parker-Majestic** Internal, External, No. 2 Surface and Rotary Surface Grinders.

Descriptive literature upon request.

PARKER-MAJESTIC, INC.

formerly MAJESTIC TOOL & MFG. CO.

147 JOS. CAMPAU • DETROIT 7, MICHIGAN



24 HOUR *Slitting Service!*

If you operate a slitter of your own, you may always enjoy this kind of service. Think what a blessing it is to be able to meet expected and unexpected needs for slit strands on such short notice—how greatly it simplifies production planning—how it eliminates production bottlenecks and minimizes strip inventories.

Then, too, when you buy strip in standard widths, your strip supply sources are more numerous. You buy wherever you get the best delivery, price, and quality.

Slitting service now may cost you anywhere from $10.00 to $100.00 or more per ton. Even if your needs were only 50 tons per month, at an average of $20.00 per ton for slitting, the cost per year would be $12,000.00—an amount which alone may be more than sufficient to make a Yoder slitter highly profitable.

The Yoder Slitter Book (sent on request) analyzes and discusses the economics as well as the mechanics of slitter operation. Yoder engineers will be glad to study your needs and submit recommendations as to kind, size, and cost of suitable slitting equipment.

THE YODER COMPANY • 5525 Walworth Avenue, Cleveland 2, Ohio

Complete Production Lines

- ★ COLD-ROLL-FORMING and auxiliary machinery
- ★ GANG SLITTING LINES for Coils and Sheets
- ★ PIPE and TUBE MILLS–cold forming and welding

ENGINEERING YODER MANUFACTURING

CHANGE DRILLS IN A JIFFY

NOW! ELIMINATE SPECIAL LENGTH DRILLS

Widely used in the aircraft industry, this handy 9/32" diameter LITTLE BEAVER DRILL EXTENSION and 8-1/2" x 1/4" extension rod makes small diameter, recessed drilling easy in hard-to-get-at-areas. Used on metal and wood with regular drills.

The LITTLE BEAVER DRILL EXTENSION is used in power and hand drills, lathes, drill presses, turret lathes for home workshop, production, cabinet making and boatbuilding.

All for the one low price of **5.95** PER SET POSTPAID

SET CONSISTS OF
5 EXTENSION CHUCKS
8½" x ¼" EXTENSION ROD
5 HIGH SPEED DRILLS,
Sizes 1 16"—5 32"—1 8"—
5 32"—3 16"

FITS ALL 1/4" CHUCKS

No C. O. D.'s
Send check
or M. O. to

LITTLE Beaver DRILL EXTENSION-CHUCKS

BEAVER TOOL CO.
183T New York Ave., Box 298, Huntington, N.Y.

Please send me____ sets of the Beaver Extension Chuck and Rod at $5.95 per set.

Name

Address

USE READER SERVICE CARD; INDICATE A-4-232-1

PRECISION CIRCULAR CUTTERS

MEYCO carbide tipped and solid carbide cutters have earned an enviable reputation in plants where long tool life and precision workmanship is a MUST.

These cutters can be furnished in various diameters and thicknesses to meet the requirements of individual applications.

Saws and cutters, both carbide tipped and solid carbide, will aid production and precision in your slotting, venting, slitting and grooving operations . . . and they will be manufactured to your specifications. Please furnish complete specs and quantities desired when requesting prices and indicate material to be cut. MEYCO experience in the manufacture of precision tools, since 1888, is at your disposal.

W. F. MEYERS CO., INC., BEDFORD, INDIANA

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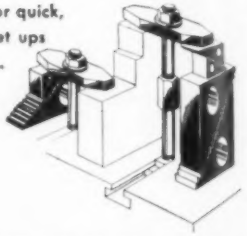
Step up Production with TTCO

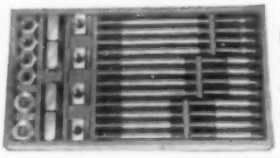
SURE GRIP STEP BLOCKS

FOR MILLERS—SLOTTERS
JIG BORERS — PLANERS
RADIAL DRILLS—LATHES

. . . used for quick, accurate set ups like this . . .



and HANDY STUD SETS



Stud sets consist of 40 pieces and provide requirements for at least 4 clamps from 3" to 15" high with T nuts for your table slot.

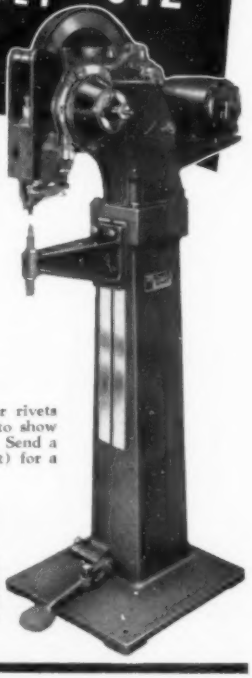
there's a size to fit your machine

write for free illustrated catalog

TIETZMANN TOOL CORP.
315-317 N. MAIN ST. • DEPT. A • ENGLEWOOD, OHIO

USE READER SERVICE CARD; INDICATE A-4-232-3

Chicago RIVET "912" AUTOMATIC RIVET SETTER CUTS COSTS 3 WAYS



1 FASTENS FASTER . . .
Only the speed of the operator limits the 912's riveting speed. Completely automatic. A push on the foot pedal automatically feeds, inserts and clinches the rivet.

2 DOES WORK OF SEVERAL MACHINES
Quick change rotary hopper and raceway makes the 912 adjustable in 5 to 10 minutes to set different size rivets. Adjustable anvil height and 12-inch throat provide further versatility.

3 SAVES ON MAINTENANCE . . .
The 912 is massively built to stand the shocks of constant use and is designed for quick, easy servicing and parts replacement.

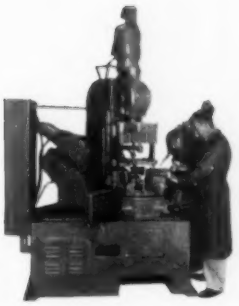
If your assembly calls for 3/16" steel tubular rivets or smaller, of 15/16" lengths or less, ask us to show you how the 912 can cut your fastening costs. Send a sample of your problem assembly (or blueprint) for a free fastening analysis.

FREE CATALOG

contains valuable engineering information and rivet specifications plus illustrated descriptions of 26 Chicago Automatic Rivet Setters.

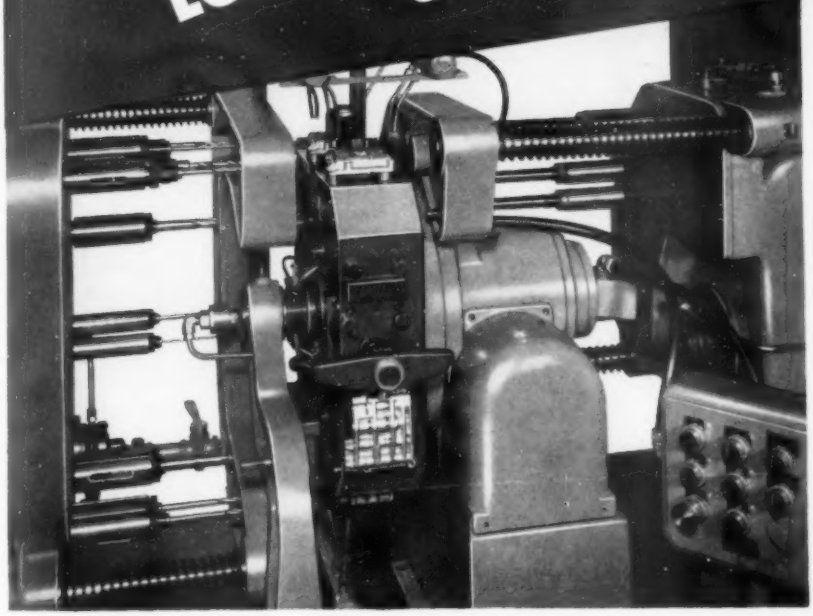
Chicago Rivet & MACHINE CO.
9619 West Jackson Boulevard, Bellwood (Chicago Suburb) Illinois
Branch Factory: Tyrone, Pa.

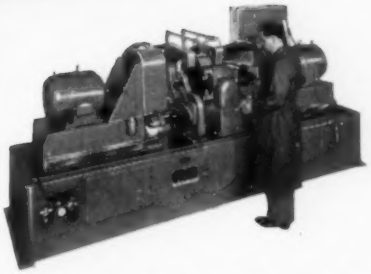
USE READER SERVICE CARD; INDICATE A-4-232-4



Closeup at the left shows a six station Hartford Automatic single purpose machine rough and finish reaming two cored holes, plus drilling two holes at different angles in die cast aluminum housings.

The LOWDOWN on HIGH PRODUCTION





This view shows a four station Hartford vertical dial type machine drilling, coredrilling and counterboring five holes in aluminum valve bodies.

Hartford Special is ready to design and build a special purpose drilling and tapping machine to boost your production, too. Why not write for more information.

When it comes to production —

HARTFORD *Special*

SUPER-SPACERS

Automatic THREAD ROLLERS

THE HARTFORD SPECIAL MACHINERY CO., HARTFORD 12, CONN.

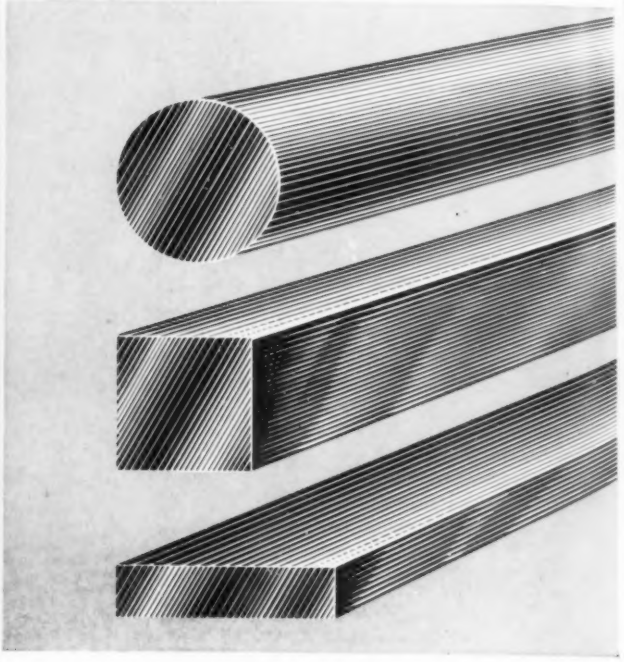
SURE SPEC DRILL ROD

genuine "Spherodized" quality tool steel!

over 200 ready to use sizes

Sure Spec Drill Rod rounds are made from the very best grades of tool steel, either Water Hardening, Oil Hardening or High Speed. They are produced from selected heats of hot rolled bars which are Spherodized, cold drawn, centerless ground and polished to a smooth mirror-like micro-finish, with exacting size tolerances.

The flats and squares are made from selected heats of Water Hardening tool steel. They are Spherodized and cold lime drawn. This imparts a superior surface finish, so they are not ground or polished. They are held to extremely close tolerances, with parallel edges and excellent machinability.



no further sizing or finishing required!

Sure Spec W—Commercial Quality (spherodized)
Water Hardening in wide safe range.

Classed as Carbon or Plain drill rod from selected heats.

Stocked from 1/16" to 2" rounds 3 and 12 ft. lengths.

Sure Spec XW—Special Quality (spherodized)
Premium Water Hardening in wide range.

Classed as selected Electric Furnace steel.
Stocked from .013 to .062 rounds 3 ft. lengths.

Sure Spec O—Oil Hardening (spherodized)
A dimension and distortion resistant Electric Furnace tool steel.

Classed as exceptionally tough and stable.
Stocked from 1/16" to 1½" rounds 3 ft. lengths.

Sure Spec HS—High Speed 18-4-11 (spherodized)
Selected Electric Furnace steel of extreme hardness for cutting.

Classed as extremely tough for high temperature work.
Stocked from 1/16" to 1" rounds 3 ft. lengths.

Sure Spec Lime-Cor—Flats and Squares.
Spherodized Water Hardening with superior finish.

Classed for excellent machinability.
Stocked in 1/16" x ⅛" to ½" x 1" flats 3 ft. lengths. 1/16" to 1" squares 3 ft. lengths.

get the best—
get Sure Spec!

"for service dependable as the sun"

SOLAR STEEL CORPORATION

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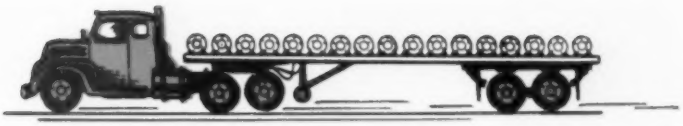
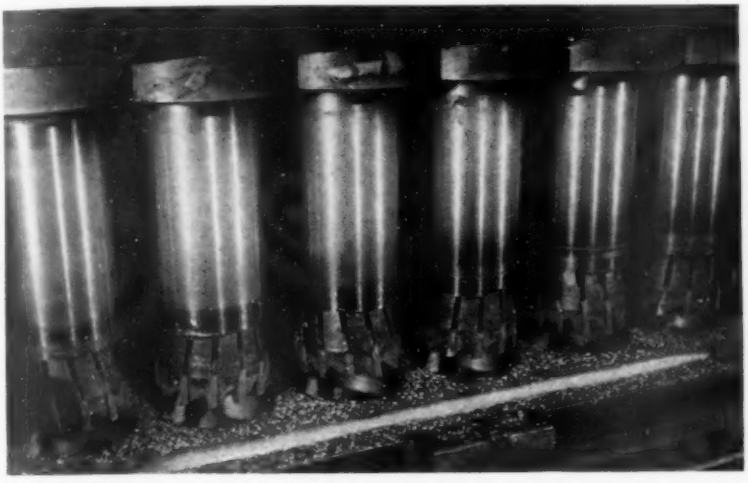
OUNCES OF WESSONMETAL CEMENTED CARBIDE!



TONS OF PRODUCTION!



ACTUAL JOB

Farm Implement Mfg. Co.

Machine	Ingersoll Boring Mill—6 spindle
Part	Cylinder block
Operation	Rough cylinder bore
Tools	3 R.H. and 3 L.H. Wesson Fine Pitch Cutters—3.480 dia.— 12 Wessonmetal Solid GI Blades
Speed	148 S.F.M.
Stock Removel	3/16"
Feed	10" per min.—.063 per revolution
Length of Cut	8⅞"

OVER 300% DOLLAR SAVINGS PER TOOL

OLD METHOD		NEW WESSON METHOD	
Pieces per Grind	836	Pieces per Grind	3160
Cost of Tool	$49.68	Cost of Tool	$172.80
Grinding Cost per sharpening	$11.70	Grinding Cost per Sharpening	$8.78
Tool Cost per 100 Pieces	$2.588	Tool Cost per 100 Pieces	$0.642

On only one machine with Wesson Tools Savings of over $900 per year

HOW IS YOUR PRODUCTION SCORE CARD!

Write today for folder on Wesson's educational, full color, sound movie— "This Carbide Age."

WESSONMETAL Cemented Carbide

WESSON METAL CORPORATION

LEXINGTON, KENTUCKY

Affiliated with WESSON COMPANY, Detroit, Mich.

ARMOR-TUF

THE AMAZING NEW STEEL HARDENING COMPOUND

"ARMOR-TUF hardens tools and steel parts as easily as baking pie, and much more quickly."

Now used by leading steel processors and other manufacturers everywhere!

You can use milder, cheaper steels for many applications and machine them before hardening. The saving is two-fold: less expensive steels and lower machining costs. ARMOR-TUF gives low carbon steels the cutting and wearing properties of tool steels. You can harden the softest steels to a degree ordinarily obtainable only in high priced steels.

Service between sharpenings increased 10 times and more. Tools hardened with ARMOR-TUF hold their edges many times longer. The advantages: substantially reduces resharpening costs . . . saves on time lost changing dull tools . . . keeps tools in service . . . enables increased production as result of less frequent tool changing and sharpening.

As compared with the usual heat treating processes, the saving in time is great. Instead of hours, only minutes are needed. The entire hardening process takes less than ten minutes.

No CYANIDE, Absolutely—ARMOR-TUF is safe to use, contains no cyanide of any kind—there are no toxic fumes.

ARMOR-TUF IS UNCONDITIONALLY GUARANTEED TO INCREASE THE LIFE OF TOOLS AT LEAST 300%, OR YOUR FULL PURCHASE PRICE WILL BE REFUNDED.

Armor-Tuf Sales Corp.
299 Madison Ave., New York 17, N. Y.

This camera helped General Mills improve a puffing gun

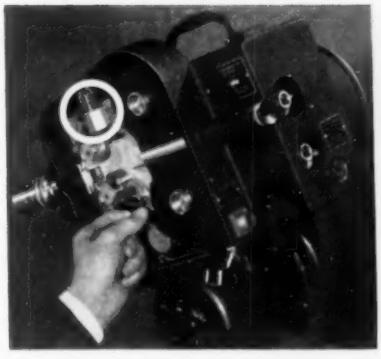
It's a tough job to improve control equipment for a part that is hidden by steam and product—and moves too fast to see.

General Mills engineers were faced with this problem in improving the operation of the "muzzle" cover on their cereal-puffing gun. To slow the event and see exactly what happened, they used their Kodak High Speed Camera. From the 16mm films it took, they got the quantitative information needed to design proper controls.

The Kodak High Speed Camera takes up to 3200 pictures a second. When the film is projected at normal speed on a standard projector, action is slowed as much as 200 times. An argon timing lamp makes it easy to get an accurate time check. And the films can be shown over and over again, stopped at important frames for detailed study and analysis.

If you have a design or performance problem that's hidden in a blur of speed, it will pay you to investigate the Kodak High Speed Camera. Our engineers will gladly help you determine its suitability to your problem. For further information or a booklet, "Magnifying Time," write to:

Industrial Photographic Division
EASTMAN KODAK COMPANY, Rochester 4, N. Y.



The cylinder encircled at the top of the camera houses an argon lamp for timing action in absolute units. As film accelerates toward its maximum speed of 50 miles per hour, light impressions on the edge mark off each 1/120 second of time.

the Kodak *HIGH SPEED* Camera

Kodak
TRADE MARK

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A product for EVERY

• Your Widest Choice of Abrasives for Every Operation

PRODUCTS	SNAGGING or ROUGH GRINDING	DEBURRING	WELD GRINDING	SMOOTHING EDGES	FINISHING and POLISHING	DIE GRINDING
Straight Wheels	✓		✓		✓	✓
Rubber Bushed Straight Wheels	✓		✓			
Mounted Wheels		✓	✓	✓		✓
Cup Wheels	✓		✓			
"MX" Straight Wheels	✓	✓	✓		✓	✓
"MX" Mounted Wheels		✓		✓	✓	✓
"MX" Discs and Depressed Center Wheels	✓	✓	✓	✓	✓	
Coated Abrasive Discs		✓	✓	✓	✓	✓
Coated Abrasive Bands and Sleeves		✓		✓	✓	✓
Cartridge Rolls		✓		✓		✓
Coated Abrasive Belts with "Port-A-Belt" Grinding Attachment	✓		✓		✓	✓

...from CARBO

TRADE

"Carborundum," "MX" and "Port-A-Belt" are trademarks of The Carborundum Company, Niagara Falls, N. Y.

PORTABLE GRINDING job

Deburring with slotted discs. You can choose the deburring method best for you from at least 7 abrasive products by CARBORUNDUM.

Weld clean-up with rubber-bushed straight wheel by CARBORUNDUM...one of 8 ways you can grind welds with portable equipment.

Rough grinding with straight wheel. This job could also be done economically with abrasive belts and the Port-A-Belt grinding attachment by CARBORUNDUM.

How can you be *sure* you're getting the highest possible production at the lowest possible cost in your portable grinding operations? By asking CARBORUNDUM—your *one source* for every type of abrasive product.

CALL YOUR CARBORUNDUM DISTRIBUTOR TODAY. He offers experienced counsel, complete stocks, prompt delivery.

RUNDUM

MARK

...the ONLY source for EVERY abrasive product you need

JIG GRINDING ACCURACY *guaranteed**

INFINITE CONTROLLED SPEEDS
30,000 TO 65,000 R. P. M.

Easily connect jig grinder to jig borer or mill

Then you can finish grind in hardened steel to "tenths" . . . jig grind dowel holes square with a ground base . . . move location of holes in hardened steel blocks . . . jig grind interchangeable holes in hardened sections . . . grind small holes with diamond impregnated mandrels . . . grind contours and relief with tungsten carbide burrs . . . grind radii in die sections . . . eliminate jig bushings in tools where close spacing is essential.

Other infinitely controlled air driven spindle applications

Place spindle on most any machine. Use it for finishing contours on hardened steel working surfaces . . . burring or milling die castings . . . routing wood contours . . . carbide milling or finishing slots . . . finishing holes in hardened steel to "tenths" . . . grinding with diamond wheels, carbide burrs, or diamond impregnated mandrels.

Advantages—10 micro finishes using carbide mills . . . 6 micro finishes using mounted points, operates at any angle . . . air driven, air cooled, overheating prevented . . . speed controlled at optimum point . . . 3⅝" long motor uses little working space . . . By controlling speed at any point you abolish need for many constant speed spindles.

For immediate quotation please state machine tool application. Get this manual of photos showing operations Vulcanaire performs.

*Dependably accurate to "tenths"

Vulcanaire
BUILT BY TOOLMAKERS FOR TOOLMAKERS

7300 LORAIN ST.,
DAYTON 10, OHIO

USE READER SERVICE CARD; INDICATE A-4-240-1

NEWEST

in industry's most complete line of filtration equipment

HOFFMAN *Vacu-matic* **FILTER**

for automatic, continuous filtering of water soluble coolant from grinders, hones and other machine tools

Write for Bulletin A-915

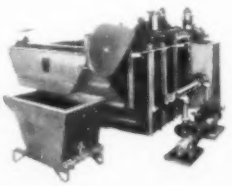
Once again Hoffman meets your particular filtration problem with equipment specifically designed for the job! The "Vacu-matic," a continuous suction, endless belt filter, serves individual machines with clean coolant *automatically*. Uses vacuum (not gravity) for high flow rates — coolant is drawn through belt which deposits solid particles as dry sludge in tote box for easy removal.

Air moving through the filter belt not only dries the sludge, it keeps coolant at or below room temperatures—reduces bacteria common to dirty coolant. The "Vacu-matic" is complete, compact, ready for hook-up on present machines. Two sizes — for 20 g.p.m. and 40 g.p.m.

High Flow Rate • Self-Cleaning
Dry Sludge • Keeps Coolant Cool

Hoffman's nationwide staff of filtration engineers is ready now to give you details on how "Vacu-matic" can protect the production of your machine tools. Like all Hoffman specialized filtration equipment, the "Vacu-matic" is designed to pay for itself by reducing down time, extending tool life, and safeguarding quality control. Write today for free technical bulletins.

For Groups of Machines
HOFFMAN FLOTATION SYSTEMS—*20 to 1,000 g.p.m.*
Fully Automatic
Write for Bulletin A-690



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INDUSTRIAL FILTRATION EQUIPMENT & SERVICE
U. S. HOFFMAN MACHINERY CORP., 227 LAMSON STREET, SYRACUSE 6, N. Y.
In Canada: Canadian Hoffman Machinery Co., Ltd., Newmarket, Ont.

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tool steel is our special pride!

Just as mother was known for a special dish, so Crucible stands for the finest in tool steel. For a half-century we have enjoyed this reputation. Naturally, we are proud of it.

We are keeping our research and development in step with industry's everchanging needs for tool steel. We are offering you the benefits of our metallurgical service to solve unusual problems. And we are maintaining full stocks in conveniently-located warehouses so you can get prompt delivery of tool steel.

SEND TODAY for the unique Crucible Tool Steel Selector—a twist of the dial gives the tool steel for your application.

Rex® High Speed Steels
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Crucible Steel Company of America
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Name_____

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9" diameter, 3-colors

CRUCIBLE first name in special purpose steels

53 years of Fine steelmaking

TOOL STEELS

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CORNELIS THREAD GENERATING MACHINE

Cuts screw threads, lead screws and worms by an improved generating method. The principle employed differs considerably from the conventional method of thread milling, lathe turning, or die chasing and will be of interest to anyone requiring work of greater accuracy and better finish, as well as higher production.

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They are terrifically popular because the six staggered cutting edges are scientifically designed to give a shearing cut and thus eliminate all chatter.
Made in 12 sizes in all degrees; also supplied as sets in strong Kit-cases.

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HARD...

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concentric . . .

Precision-made of both Carbon Vanadium and high carbon, high chrome steels. Available in a wide range of stock sizes from 1/32" to 1" point diameters in increments of 1/64" for immediate delivery. Decimal sizes to order for delivery within 48 hrs.

Button Dies

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Hole tapered to eliminate slug jamming. Sizes in stock to match punch sizes.

Write TODAY for your copy of handy data sheets covering specifications and prices; also name of distributor in your area.

Exclusive Distributor Wanted for California

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SMART DOG FANCIERS demand a pedigree!

SMART HOB BUYERS DEMAND A TOOLGRAPH* CHART

The TOOLGRAPH Chart shipped with every Illinois Tool Works Hob is an electrically produced inspection record . . . positive, not subject to human error . . . that gives hob buyers visual proof of accuracy. And even more, the TOOLGRAPH Chart is a *useful* record of specific hob characteristics that will help assure peak production performance.

Yes, like a champion's pedigree, the TOOLGRAPH Chart actually proves the value of an Illinois Tool Works Hob! It's typical of the many *plus* values that design ingenuity, metallurgy, production skill and experience add to every Illinois Tool Works Tool.

That's why smart hob buyers like the TOOLGRAPH Chart . . . and specify Illinois Tool Works Hobs!

"Headquarters for Engineered Cutting Tools"

Announcing

the new "FETTE" PATENT thread rolling head

self-opening

Exclusively by

NATIONAL ACME

more accurate

stronger

smoother

cheaper

and 5 times faster than die head thread chasing

This new precision method of chipless thread forming embraces features resulting in economies to an extent found in no other tool.

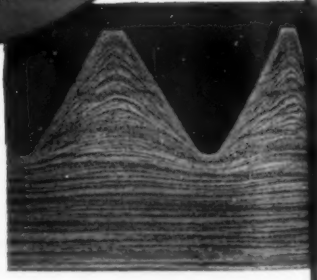
The method produces a highly densified thread surface, wear resistant and exceptionally smooth. Feed of work follows lead of thread—no lead screw or follow-up cam required.

Rolling speeds are equivalent to turning speeds of same materials with high speed tools. Many thousands of linear feet can be rolled with one set of thread rolls.

Annular grooved rolls are positioned in plates in the head and plates are not changed for standard coarse or fine pitch of same thread form. Fine diametric adjustment is provided.

Further economies result in the small initial purchase price of the head as against special single purpose thread rolling machines.

Both revolving or non-revolving heads are suited to all horizontal or vertical machines. Currently built in 3 standard sizes covering range $\frac{1}{4}$ to $\frac{3}{4}$" National coarse or fine straight threads. Other sizes and forms of application.

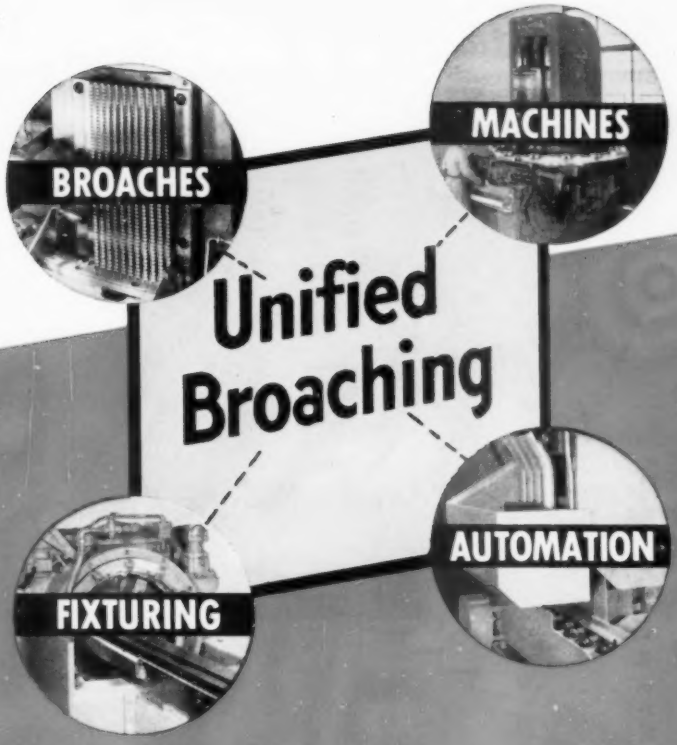


Material rolled flows in an axial direction so that the thread is generated ahead of the rolls causing metal to flow to the full depth of thread, also eliminating broken grain structure at crest of thread.

Manufactured and sold in U. S. A. only by the makers of NAMCO CIRCULAR CHASER SELF OPENING VERS-O-TOOL HEADS AND COLLAPSIBLE TAPS

The NATIONAL ACME COMPANY

170 EAST 131 STREET • CLEVELAND 8, OHIO



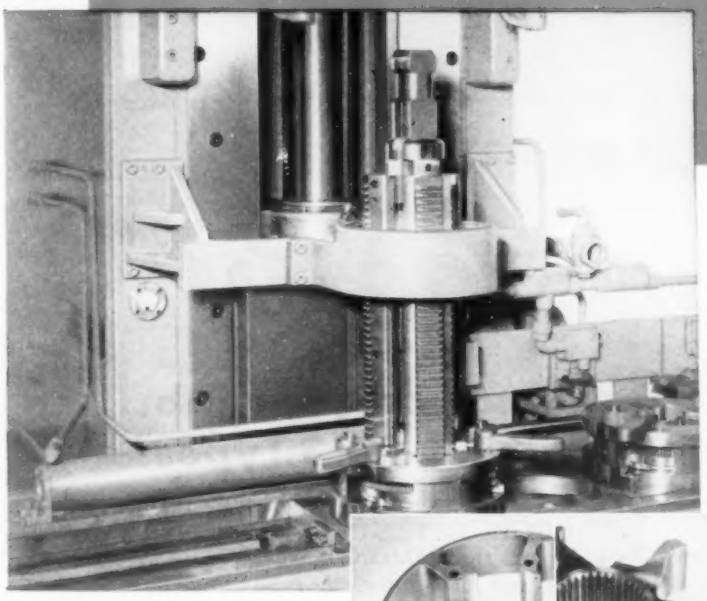
The New Trend...

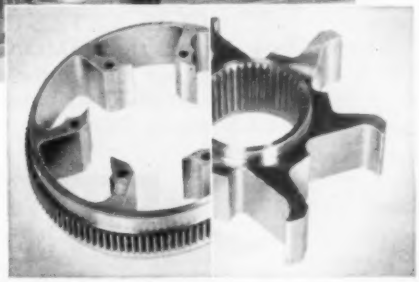
the COLONIAL method

At Colonial, experience, imagination and competence are applied

1 to the design and manufacture of each of the individual components of a complete broaching installation, and

2 to the effective combining of ALL components into a completely UNIFIED BROACHING installation—making them work as a "team."





3 Colonials Broach Intricate Aero Parts

Three Colonial broaching machines rough and finish broach these two mating aircraft engine parts. Six internal contours on the body are broached on a 15-ton Model RD pull-down (illustrated). The spider's external contours are broached on a Model RS 6-ton single ram and internal involute splines on a 15-ton Model RD pull-down machine.

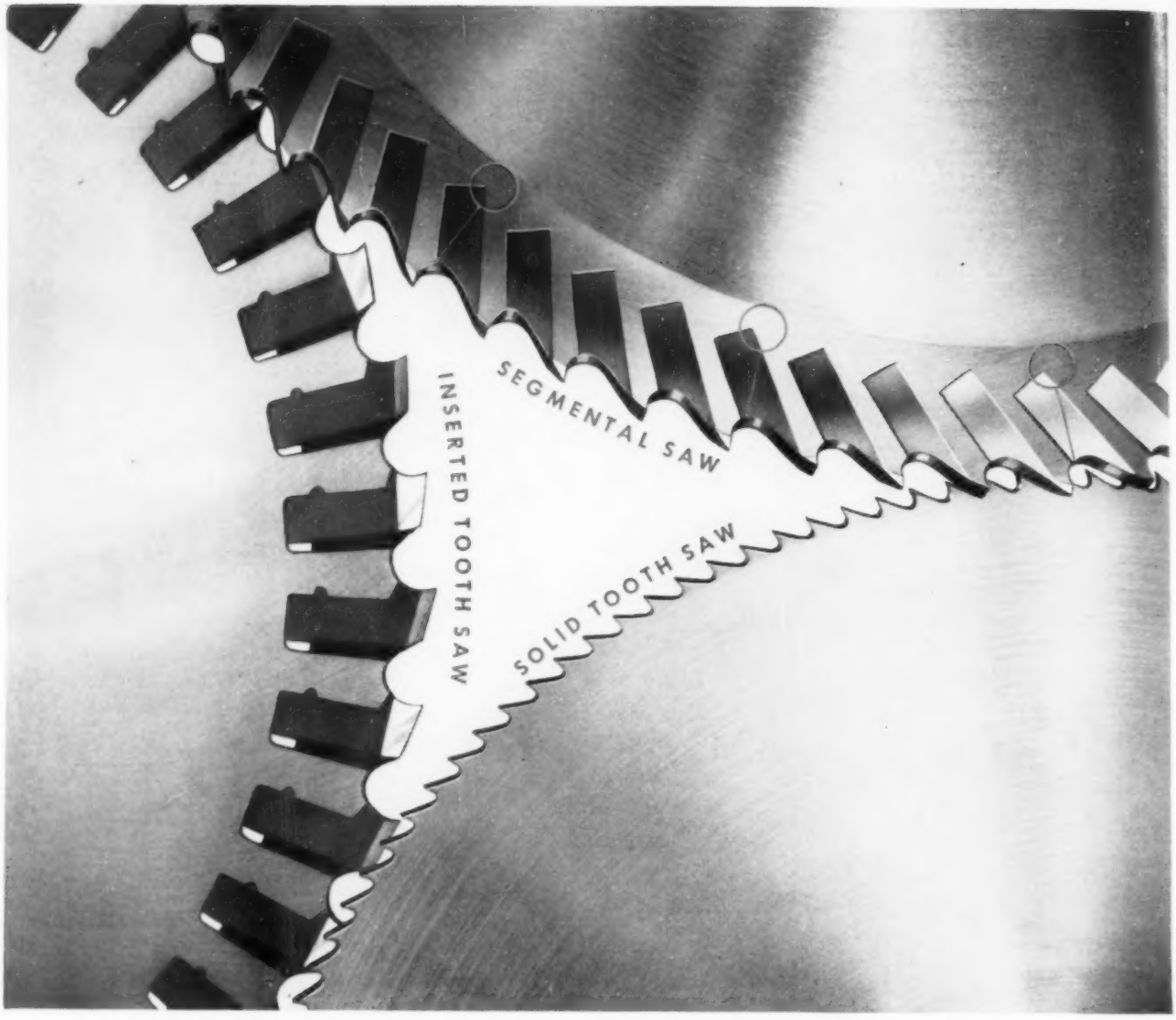
Machines, broaches, fixtures, etc., were all designed by Colonial as a UNIFIED BROACHING INSTALLATION.

WHAT'S AHEAD IN BROACHING?

Keep up with the latest developments: Read "Broaching News". We will be glad to see you get it regularly if you will drop us a line on your company letterhead.

PIONEERS OF H.S.S. BROACHING

COLONIAL BROACH CO. DETROIT 13



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For the best saw-performance on your job... SIMONDS gives you a choice of *All 3 Types!*

INSERTED TOOTH: For heavy production cutting of all steel, brass, copper, and aluminum. Alternating square and beveled teeth "tri-vide" chips for easy cutting and clearance. Teeth can be easily replaced, singly or in complete sets, in your own plant by any average mechanic.

SOLID TOOTH: For general shop cut-off jobs . . . for use on smaller automatic cut-off machines and for cutting jobs where narrow kerf is important.

SEGMENTAL: For especially smooth cuts on production work. High Speed steel toothed segments are securely held in a tough alloy plate by a special tongue and groove design, have quick clearance for faster, freer cutting.

SIMONDS MAKES ALL THREE TYPES OF CIRCULAR METAL-CUTTING SAWS. So you can be sure that SIMONDS will give you *the right saw for your job* . . . for any type of machine. See your Simonds Distributor today, or write the nearest Simonds Office.

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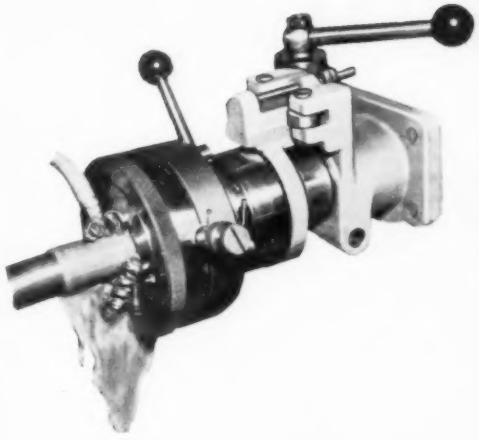


HOLDERS

for Jones & Lamson Die Heads

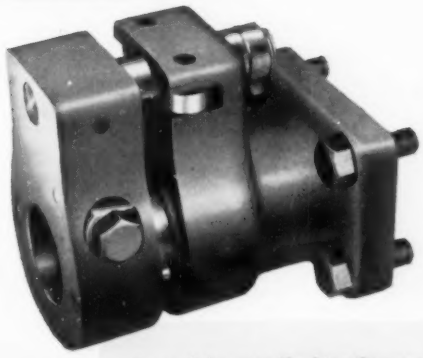
The best of Die Heads deserves the best of holders. With these holders, the extreme accuracy of your J&L Die Heads is reflected in the quality of the threads they produce. Holders for J&L Die Heads are available for most makes of turret lathes. Mail this coupon for a copy of the new illustrated catalog.

LEVER OPERATED DIE & TOOL HOLDERS

for more sensitive control. Eliminate side trimming. Hold reamers, taps and small drills.

FLANGE TYPE HOLDERS

ideal for threading long work that must pass through the face of the turret.



AXIAL FLOAT HOLDERS

for smooth, shock-free starting, better finish threads.

Jones & Lamson Machine Company
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J&L

Machine Tool Craftsmen Since 1835

DIE HEAD

Dept. 710

Switch to Graph-Mo® ends heat-treating problem, increases gage blank sales!

Graph-Mo steel gage blanks manufactured by HURON MACHINE PRODUCTS, Dearborn, Michigan.

HURON Machine Products was having trouble heat-treating the oil-hardening tool steels it used for making gage blanks. Poor response to heat-treatment was causing cracks in the blanks.

Looking for an answer to the problem, Huron switched to Graph-Mo® steel, a special graphitic tool steel manufactured by the Timken Company.

Here's what happened when Graph-Mo steel was used:

Because Graph-Mo responds uniformly to heat-treatment, the cracking problem was eliminated. But that's not all.

Because Graph-Mo machines faster, machining time was cut, tool life lengthened.

And in addition to cutting production costs, Graph-Mo has helped Huron increase its sales. H. E. Lindemann, Huron president reports: ". . . the acceptability of Graph-Mo by gage users has been an important factor in our company's increased sales."

The difference in Graph-Mo steel and other gage steels can even be seen by the naked eye. The tiny, scattered parallel marks barely visible on the surface of a polished piece of Graph-Mo steel indicate the presence of free graphite in the steel's structure. This graphite, together with diamond-hard carbides, enables Graph-Mo to outwear other tool steels an average of 3 to 1, according to reports from dozens of users.

You can always tell Graph-Mo by its "graphitic look". This built-in trade-mark can't be duplicated in other steels. The next time you buy gages look for the "graphitic look" as well as the tag reading "this gage is made of Graph-Mo steel". The Timken Roller Bearing Company, Steel & Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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SPECIALISTS IN FINE ALLOY STEELS, GRAPHITIC TOOL STEELS AND SEAMLESS TUBING

Special Tools of Quality Engineered to Save Your Time

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SIZE IDENTIFIED ASSEMBLY SIMPLIFIED

The Only

SIZE-MARKED GEAR GRIP SOCKET HEAD CAP SCREW

The size is clearly incised on the head, can be seen at a glance. It prevents errors by "green" workers, helps veterans also to speed assembly. It saves time and wasted screws when sizes get mixed up.

It's a sales feature for your product. Your customers' maintenance men will like the Size-mark . . . it aids them in reassembling after servicing. Gear Grip prevents slips, speeds work, even when fingers are oily.

Since there is no better Socket Head Cap Screw made, why not get these important extra features offered only by P-K? Ask for samples. Parker-Kalon Corp., 200 Varick St., New York 14, N.Y.

FOR ANY TYPE SOCKET SCREW—
REMEMBER

IF IT'S **P-K** IT'S O.K.

TRADE MARK REG. U.S. PAT. OFF.

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Sold through Industrial Distributors, the Supply Specialists that serve you

Cold-forged **SOCKET SCREWS**

CAP FLAT HEAD BUTTON HEAD SHOULDER SET HEX KEYS

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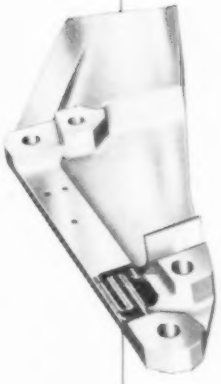
where *Precision* counts

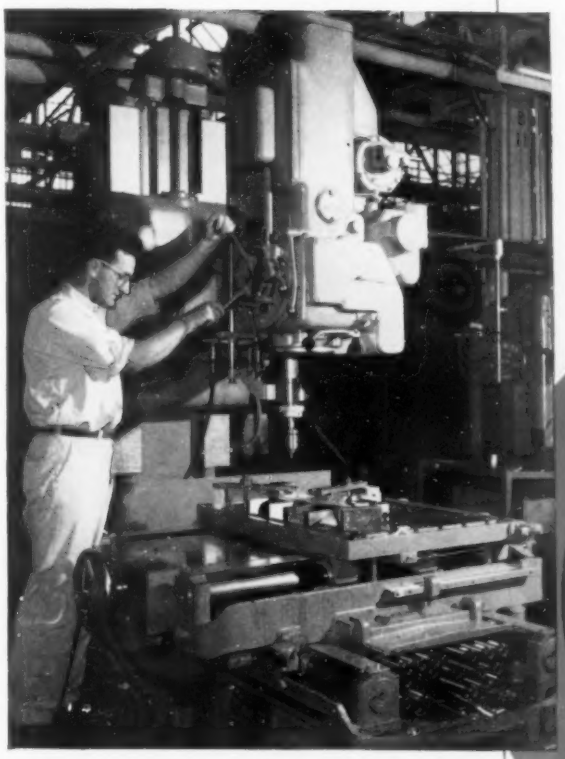


a natural combination hard to beat . . .

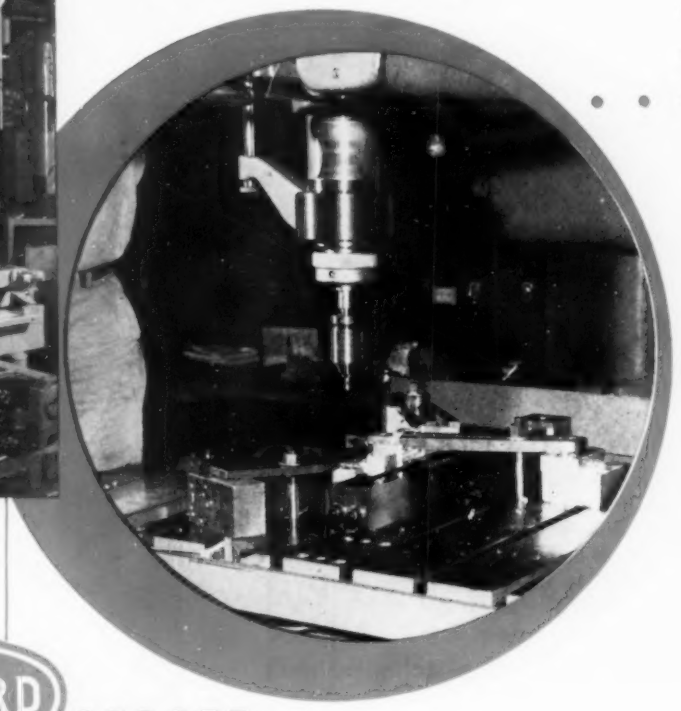
Bullard 30 x 20 Spacing Table installed on Cincinnati-Bickford fixed arm Precision Drilling Machine at Convair (Consolidated Vultee Aircraft Corporation, San Diego, California) is proving that these two units "pay-off" in elimination of jig cost, speeding-up production and accuracy in repetitive drilling on a variety of work.

A new job goes into immediate production with no lost time — no waiting for preparation of jigs.

Simple and comparatively fast change-over from one job to another minimizes production tie-ups.



Precision work materially reduces if not entirely eliminating spoilage and provides complete interchangeability of parts.



BULLARD SPACER

Ask for information on Precision Drilling without Jigs

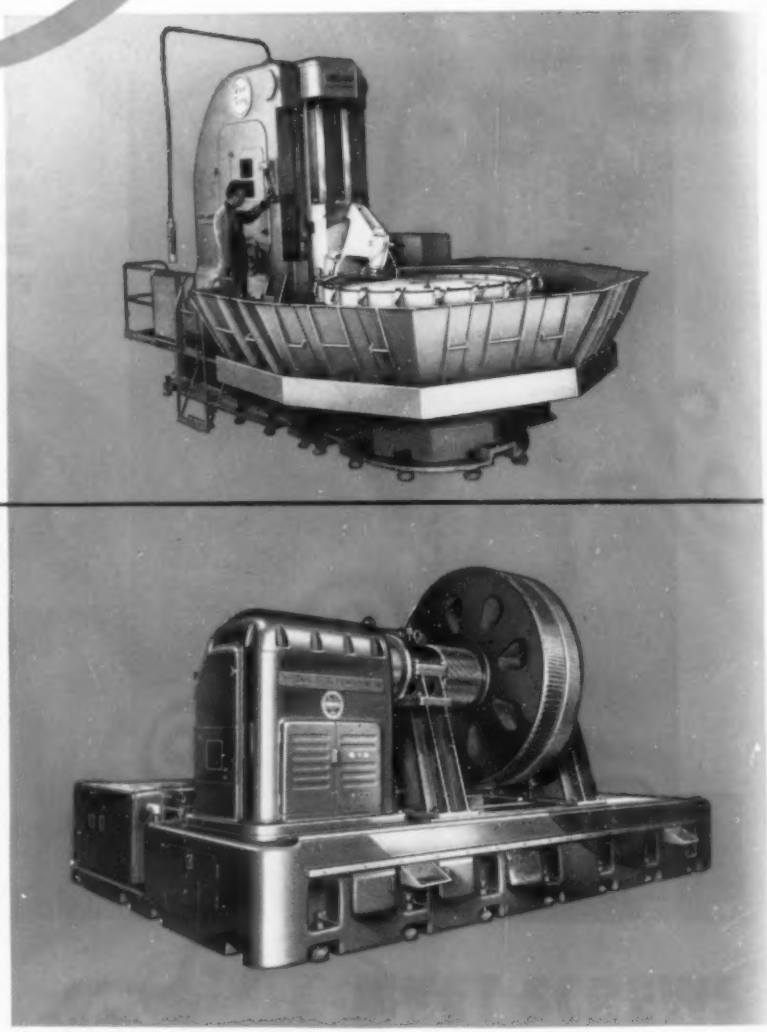
We Can Offer Favorable Deliveries on Bullard Spacers

. . . THE BULLARD COMPANY . . . .

BRIDGEPORT 2 • CONNECTICUT

FOR FURTHER INFORMATION, USE READER SERVICE CARD; INDICATE A-4-251

Large marine gear finishing practice moves ahead



ABOUT 11 years ago the first Red Ring machine for shaving large marine propulsion gears (up to 96" PD) was completed and put into commission. Its high precision and spectacular economy promptly initiated the now accepted practice of shaving for such gears.

Since then Red Ring machines have been built to shave larger ma-

rine gears. The United States, our fastest and largest ocean liner, launched last year, is driven by reduction gears shaved on Red Ring machines.

And now, nearing completion is a giant shaving machine to finish marine gears 15 feet in diameter to almost incredible tolerances on tooth form, pitch, lead and surface finish. With slight modifications, this unit will handle gears up to 200" PD. It will be displayed to this company's guests late in April.

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WORLD'S LARGEST PRODUCER OF GEAR SHAVING EQUIPMENT

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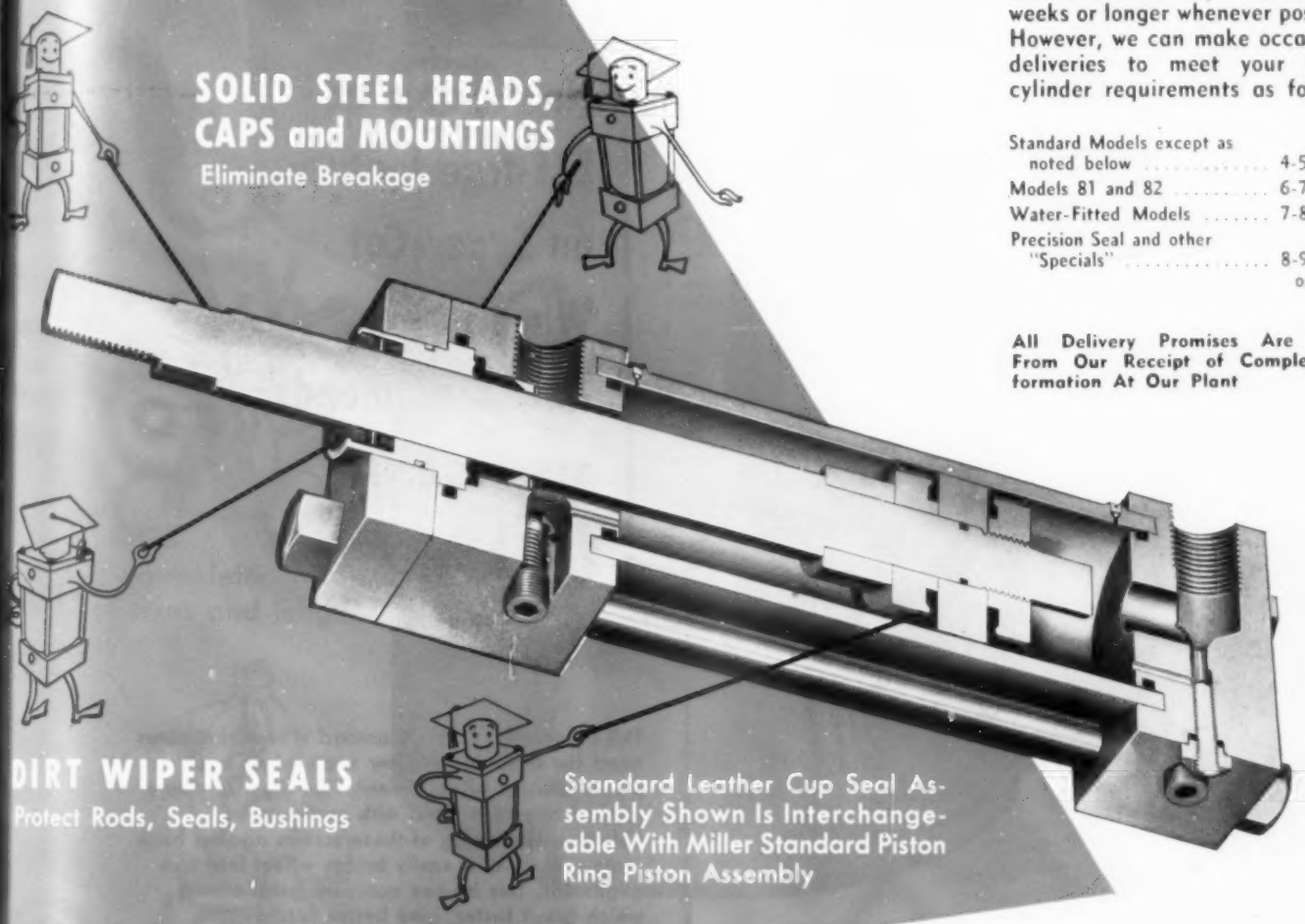
ME PLATED
ON RODS
Scratch-Damage,
d Rust

SOLID STEEL HEADS, CAPS and MOUNTINGS
Eliminate Breakage



DIRT WIPER SEALS
Protect Rods, Seals, Bushings

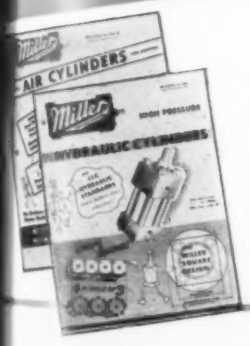
Standard Leather Cup Seal Assembly Shown Is Interchangeable With Miller Standard Piston Ring Piston Assembly

DELIVERY

Our normal delivery is now 8 to 10 weeks or longer whenever possible. However, we can make occasional deliveries to meet your RUSH cylinder requirements as follows:

Standard Models except as noted below	4-5 weeks
Models 81 and 82	6-7 weeks
Water-Fitted Models	7-8 weeks
Precision Seal and other "Specials"	8-9 weeks or longer

All Delivery Promises Are Dated From Our Receipt of Complete Information At Our Plant



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Complete Miller cylinder line includes: air cylinders, 1½" to 20" bores, 200 PSI operation; low pressure hydraulic cylinders, 1½" to 6" bores for 500 PSI operation, 8" to 14" bores for 250 PSI; high pressure hydraulic cylinders, 1½" to 12" bores, 2000-3000 PSI operation. All mounting styles available.

MET J. I. C. HYDRAULIC STANDARDS years before their adoption in 1949.

SPACE-SAVING SQUARE DESIGN originated by Miller in 1945.

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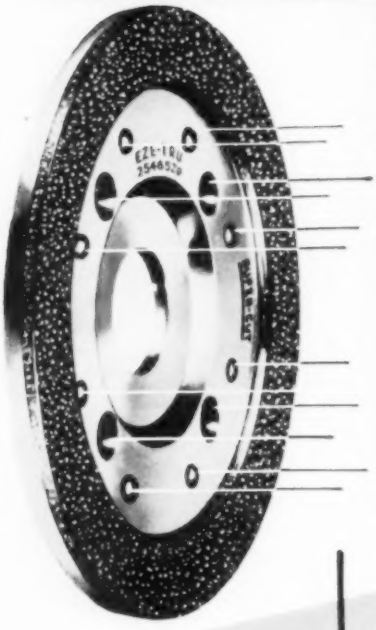
AIR & HYDRAULIC CYLINDERS • BOOSTERS • ACCUMULATORS
COUNTERBALANCE CYLINDERS

You Can Align This Diamond Wheel *Quickly!*



New, patented EZE-true feature on Super-Cut Wheels save time & diamonds assures *better finishes . . .*

This patented EZE-TRU Diamond Wheel eliminates need for shimming up low spots when back plates are out of alignment. Has eight auxiliary tapped openings fitted with small screws. Selective tensioning of these screws against back plate quickly and easily brings wheel into true alignment. This insures accurate installations which grind faster, give better finishes and prolongs wheel life.

Send for Price List and full details...

This EZE-TRU feature can be supplied on 6", 7" and 10" diameter, shallow or plain cup type wheels. For prices and full details, write to:

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Super-Cut Distributors, Inc.
3418 N. Knox Ave., Chicago 41, Ill.
Gentlemen:
Please send me full information and prices on your line of EZE-TRU Diamond Wheels

Name_____

Firm_____

Address_____

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GIVE YOU ALL THESE OUTSTANDING FEATURES

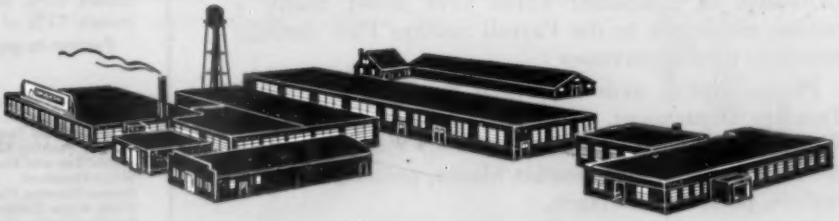
1—super finish reduces wear to a minimum

2—blended radius reduces tool hang up

5—complete variety of sizes and lengths

4—knurled head provides quick sure grip

3—100% concentricity and hardness tests assure accuracy



The modern home of finer production tools

UNIVERSAL ENGINEERING COMPANY
Frankenmuth 3, Michigan

165

"Some 15,000 employees in all branches of our organization are taking advantage of the Payroll Savings Plan..."

SPENCER LOVE
Chairman of the Board, Burlington Mills

"The Payroll Savings Plan is one of the important personnel services offered to the employees of our company. At the present time some 15,000 employees in all branches of our organization are taking advantage of this splendid plan for systematic savings. In times of national emergency this plan assists in stabilizing the economic life of the employee, the community and the nation."

Last call for the 1951 Defense Bond Campaign!

While the campaign was scheduled for six weeks, beginning Labor Day, the *accounting period* will include all Payroll Savings Plan bond purchases and enrollments in September *and October*.

If *you* haven't conducted a person-to-person canvass to put a Payroll Savings Blank in the hands of every man and woman in *your* company there is still time to join the thousands of companies which have added nearly a million employees to the Payroll Savings Plan through person-to-person canvasses.

Phone, wire or write to Savings Bond Division, U. S. Treasury Department, Suite 700, Washington Building, Washington, D. C. Your State Director will give you all the help you need—application blanks, posters, envelope stuffers, personal assistance.

Give your employees an opportunity to save for their future and at the same time, help to maintain America's economic security—put an application blank in their hands.

Results of a few recent person-to-person canvasses

Firestone Tire and Rubber Company (40,000 employees), 87% participation; Universal Atlas Cement Company, 67.8% of 4,789 employees . . . Martha Mills, 71% of 2,200 employees . . . Lit Brothers, 52% of 3,600 employees . . . Delta Air Lines, 65% of 2,100 employees; Aerojet Engineering Corporation, 78.1% of 2,000 employees . . . Brown-Lipe Chapin Division of General Motors, 87% of 1,750 employees; Fabricast Division, General Motors, 85% of 1,700 employees.

Person-to-person canvasses now under way include:

	Number of Employees
38 Major Railroads	993,142
Radio Corporation of America	40,000
Owens-Illinois Glass Company	25,000
Cudahy Packing Company	17,000
Pacific Gas and Electric	17,000
Willys-Overland	6,750
Owens-Corning Fiberglas Corp.	6,500
White Motor Company	6,300
Fruehauf Trailer Company	5,700

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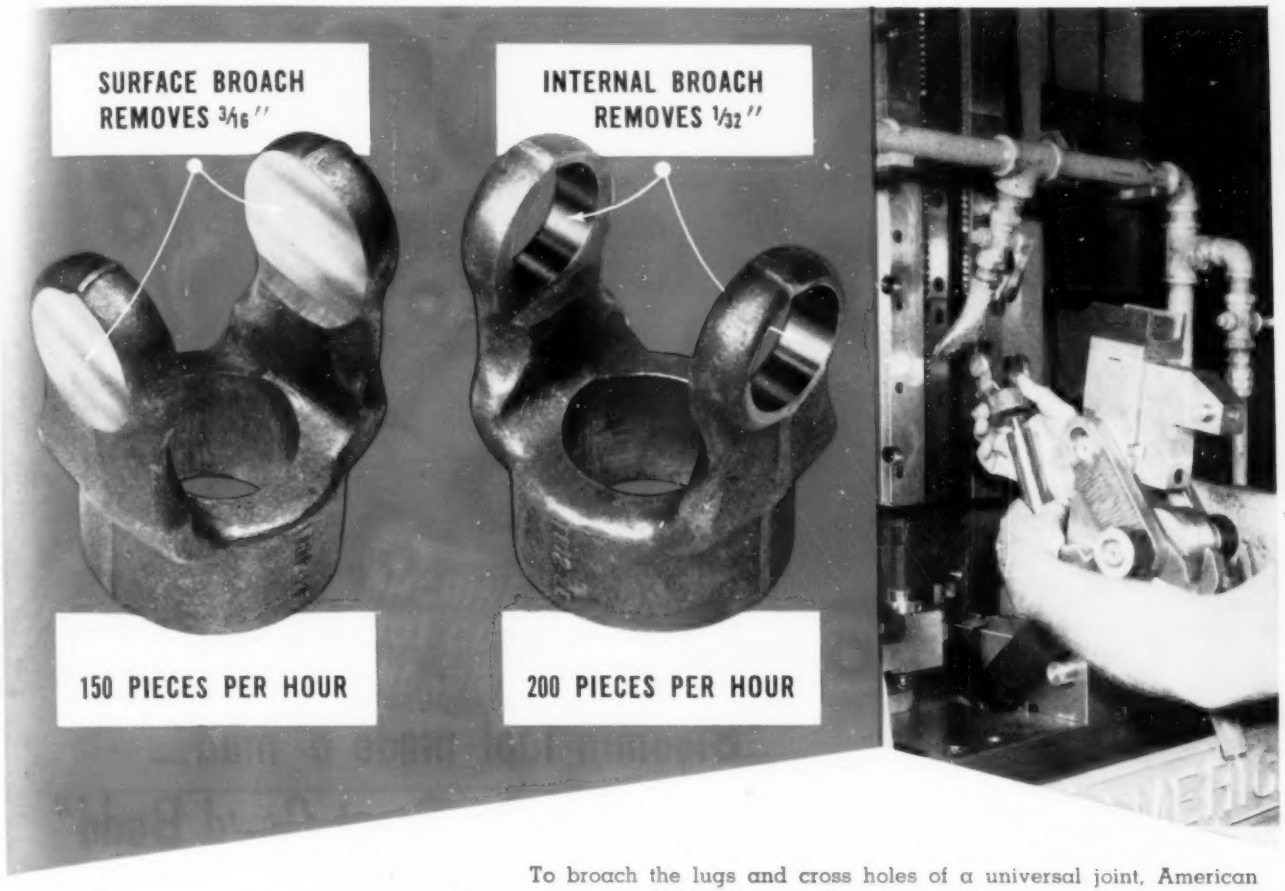
one American broaching machine



surface and internal broaching possible with American 3-way machine

To broach the lugs and cross holes of a universal joint, American engineers designed a combination tooling set-up on a standard American T-10-36 3-way machine.

Arranged with 3 stations, the machine surface broaches 3/16 stock off the inside and outside surfaces of the lugs at the center station; or broaches 1/32 off the I. D. of the lug cross holes at the two outer stations. The versatility of the American 3-way machine allows for a permanent tooling set-up, to handle both operations.

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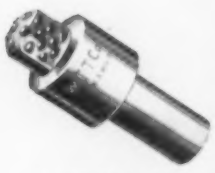

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—KIPLING

The two French soldiers crouched and watched the white little beam of Indian sunlight creep into the eye of the great gilded image across the shadowy chamber. Suddenly, the eye blazed and flashed with brilliant, jewelled fires.

"Diamantes!" they whispered, and rushed over and clambered up to the great face. A few moments later they ran out into the turmoil and gunfire in the streets and fled with the rest of the French soldiery, retreating before Captain Clive's victorious Sepoys.

A diamond as big as a walnut and weighing 200 carats isn't the easiest thing to trade, but, eventually, it reached an Armenian dealer who sold it to the Russian Count Orloff for $560,000. The Count diplomatically presented it to the Empress Catherine, who was so pleased that she gave him a half-million dollar grant and another title.

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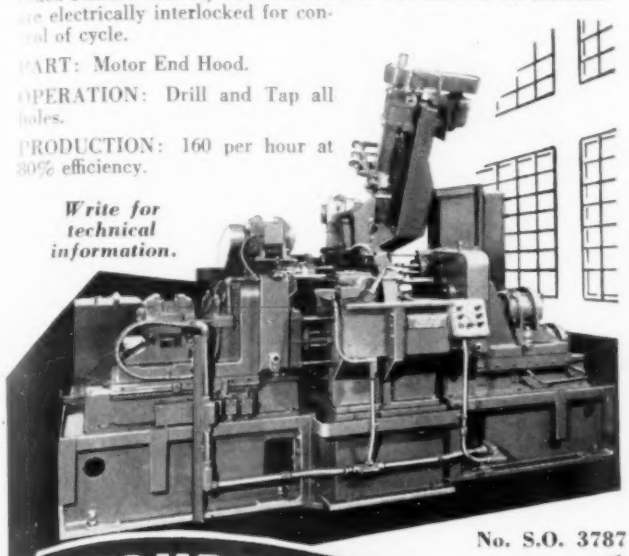

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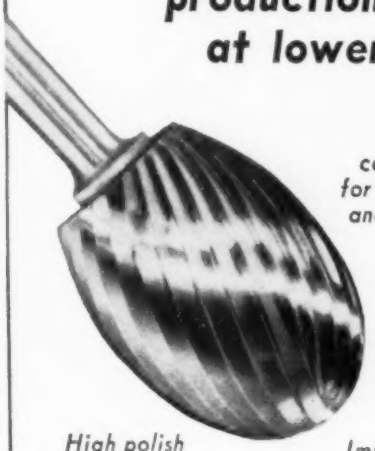

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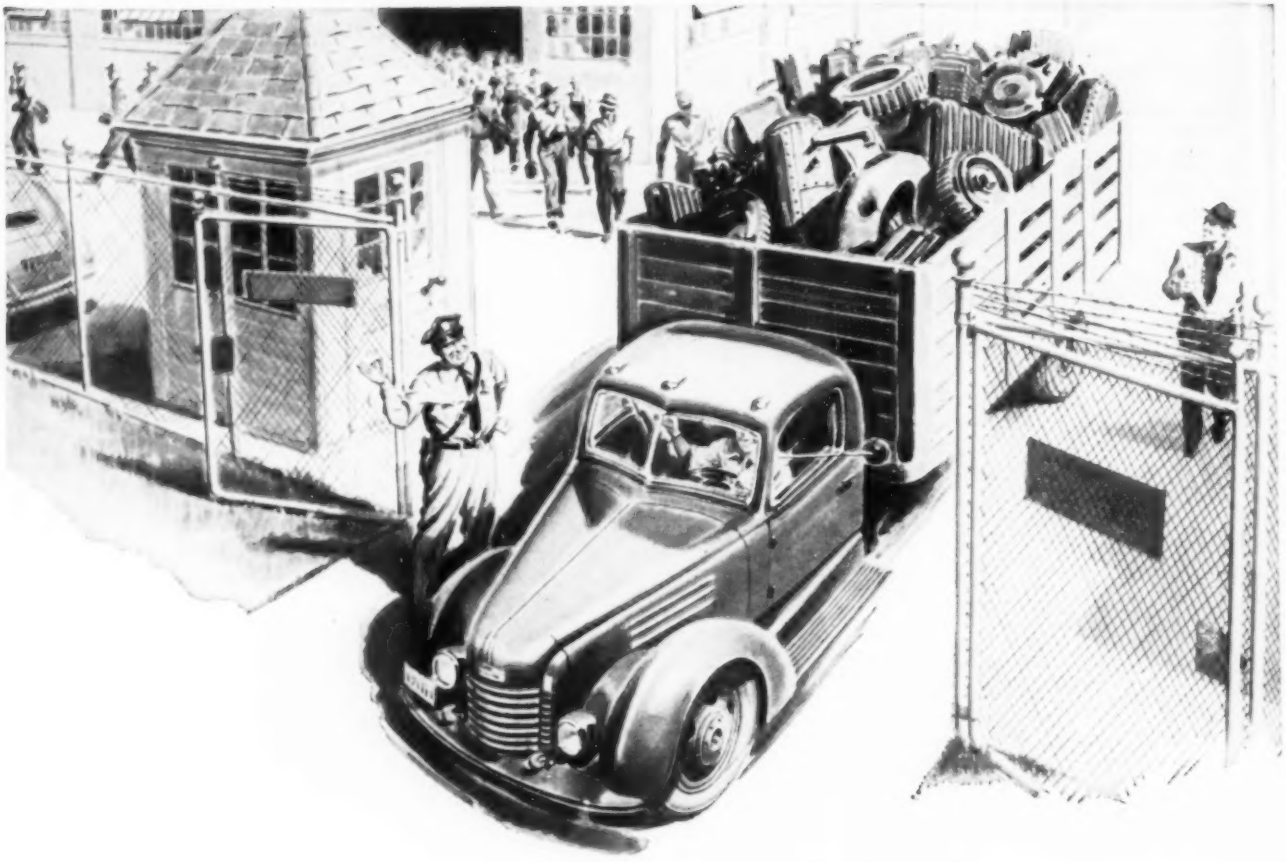

Scrap's valuable!.. Scrap's precious!

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Every plant has some—search out the iron and steel scrap in yours

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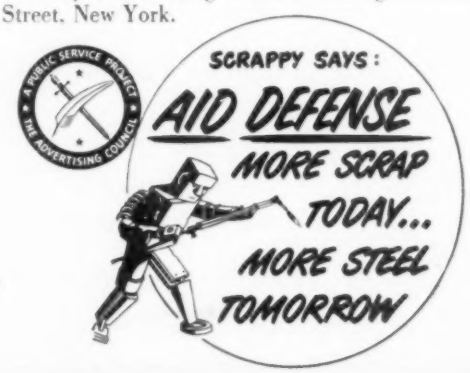

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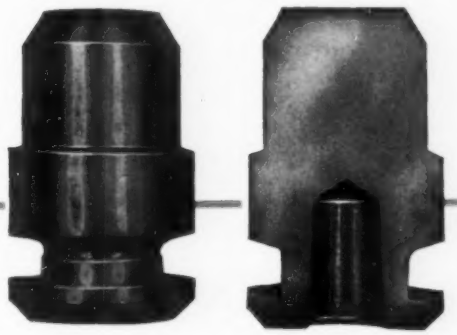

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RUSSELL, HOLBROOK & HENDERSON, INC.

292 MADISON AVENUE, NEW YORK 17, N. Y.

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April, 1953

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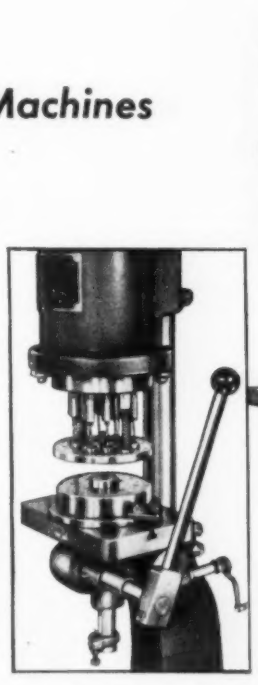

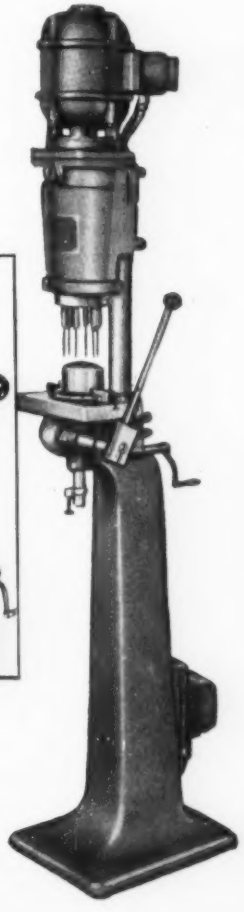

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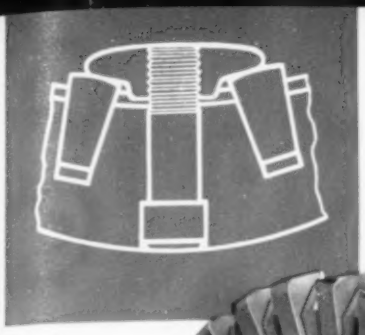
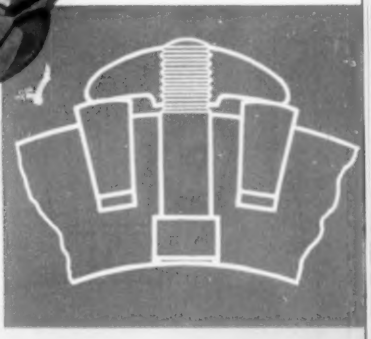


Continental Inside Cone Face Mill with illustration showing how blades are locked in the rugged body.

Continental Outside Cone Face Mill with illustration showing how blades are locked.



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